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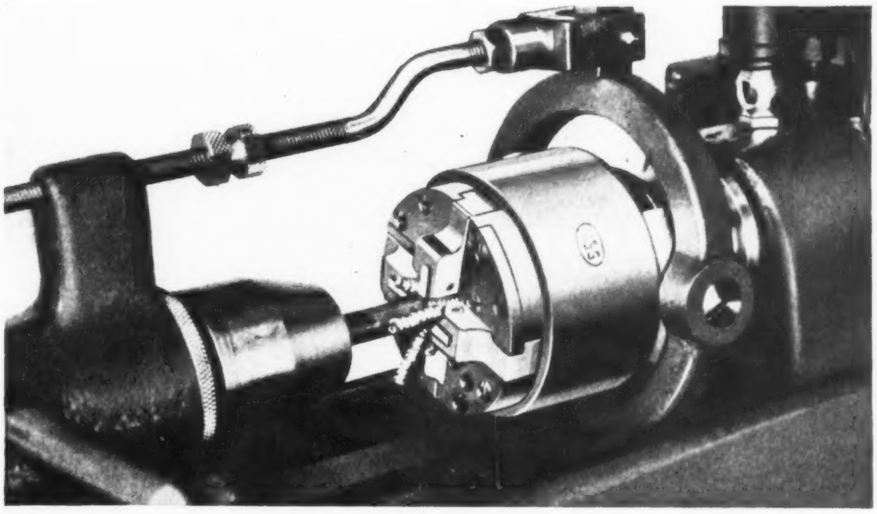
The Design of Threaded Parts



Suggestions Relating to the Various Factors that Must be Taken into Consideration in Designing and Specifying Threaded Parts to Obtain the Greatest Mechanical Efficiency and Economical Production

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THE author of this article has the opportunity of seeing samples, drawings, and specifications of hundreds of newly designed threaded parts every year. Having noted that in many instances threaded parts are designed and specified in a manner that provides neither for the best mechanical efficiency nor for the most economical production, he feels prompted to place on record certain suggestions, recommendations, and comments which, if more generally heeded, would result in considerable savings and would simplify the manufacture of such parts.

It is hoped that the publication of the suggestions in this article may aid in reducing the number of special sizes and "freak" threads now being so frequently ordered. The article will deal with such subjects as the selection of thread sizes, gaging methods, tolerances, materials, shoulder threading, multiple threads, Acme threads, helix angles, strength of threads, etc.

Thread sizes should be selected, when possible, from the standards adopted by the American Standards Association and the Screw Thread Commission. These are the American-National Coarse Thread Series (Table 1) and the American-National Fine Thread Series (Table 2). There are also the so-called 8-, 12-, and 16-pitch series that appear in the 1933 report of the Screw Thread Commission and in the American Standard Association B 1.1 1935 Report on Screw Threads. These tables provide further approved sizes, from which selections can be made.

For screws used for fastening, the diameter of the thread is determined by the strength required or the space available. Unless there are other considerations, such as the speed of assembly, the number of threads per inch for a given diameter should be selected from the Fine Thread Series. This series is quite generally used in the automotive and aircraft industries because the helix angles are

Table 1. American Coarse Thread Series Screws and Tapped Holes

All Dimensions in Inches

Thread Size	Basic Dimensions				Pitch Diameter Limits and Tolerances									
					Class 2					Class 3				
	Major Diameter	Basic Depth	Pitch	Basic P.D.	Screws		Tolerance	Tapped Holes		Screws		Tolerance	Tapped Holes	
					Max.	Min.		Min.	Max.	Max.	Min.		Min.	Max.
No. 5-40	0.1250	0.01624	0.02500	0.1088	0.1088	0.1064	0.0024	0.1088	0.1112	0.1088	0.1071	0.0017	0 1088	0.1105
No. 6-32	0.1380	0.02030	0.03125	0.1177	0.1177	0.1150	0.0027	0.1177	0.1204	0.1177	0.1158	0 0019	0.1177	0.1196
No. 8-32	0.1640	0.02030	0.03125	0.1437	0.1437	0.1410	0.0027	0.1437	0.1464	0.1437	0.1418	0.0019	0.1437	0.1456
No. 10-24	0.1900	0.02706	0.04167	0.1629	0.1629	0.1596	0.0033	0.1629	0.1662	0.1629	0.1605	0.0024	0.1629	0.1653
No. 12-24	0.2160	0.02706	0.04167	0.1889	0.1889	0.1856	0.0033	0 1889	0.1922	0.1889	0.1865	0.0024	0 1889	0.1913
1/4-20	0.2500	0.03248	0.05000	0.2175	0.2175	0.2139	0.0036	0.2175	0.2211	0 2175	0.2149	0.0026	0.2175	0.2201
5/16-18	0.3125	0.03608	0.05556	0.2764	0.2764	0.2723	0.0041	0.2764	0.2805	0.2764	0.2734	0.0030	0.2764	0.2794
3/8-16	0.3750	0.04059	0.06250	0.3344	0.3344	0.3299	0.0045	0.3344	0.3389	0.3344	0.3312	0.0032	0.3344	0.3376
7/16-14	0.4375	0.04639	0.07143	0.3911	0.3911	0.3862	0.0049	0.3911	0.3960	0.3911	0.3875	0.0036	0.3911	0.3947
1/2-13	0.5000	0.04996	0.07692	0.4500	0.4500	0.4448	0.0052	0.4500	0.4552	0.4500	0.4463	0.0037	0.4500	0.4537
9/16-12	0.5625	0.05413	0.08333	0.5084	0.5084	0.5028	0.0056	0.5084	0.5140	0.5084	0.5044	0.0040	0.5084	0.5124
5/8-11	0.6250	0.05905	0.09091	0.5660	0.5660	0.5601	0.0059	0.5660	0.5719	0.5660	0.5618	0.0042	0.5660	0.5702
3/4-10	0.7500	0.06495	0.10000	0.6850	0.6850	0.6786	0.0064	0.6850	0.6914	0.6850	0.6805	0.0045	0.6850	0.6895
7/8-9	0.8750	0.07217	0.11111	0.8028	0.8028	0.7958	0.0070	0.8028	0.8098	0.8028	0.7979	0.0049	0.8028	0.8077
1-8	1.0000	0.08119	0.12500	0.9188	0.9188	0.9112	0.0076	0.9188	0.9264	0.9188	0.9134	0.0054	0.9188	0.9242

Note: To find the basic minor diameter of any screw, subtract the basic depth from the basic pitch diameter.—The tolerances on the major diameter for Class 2 and Class 3 fits are twice the pitch diameter tolerances shown for Class 2 fits.—The basic width of flat is one-eighth the pitch.

smaller, and hence, the screws are less likely to be shaken loose by vibration. The core or minor diameter of the screw is greater, which gives it greater strength. There are more threads engaged for a given length of engagement, and less material is removed in cutting the thread. Also, full threads may be cut closer to a shoulder for a given angle or chamfer on the tools.

Selecting the threads from either the Coarse or Fine Thread Series has many manufacturing advantages: First, the cost of the tools is usually lower, because they are in general demand; second, standard tolerances have been established that have been found satisfactory; third, standard gages are immediately available, and at much less cost than special gages.

As already referred to, it is surprising to note how many designers specify threaded parts on which the thread size is special—diameters expressed in decimals of an inch with very odd and unusual pitches. Probably there is nothing more aggravating to the user of machinery than to find, after he has purchased a piece of expensive equipment, that its threaded parts are all special sizes, and repairs are, therefore, very difficult and costly.

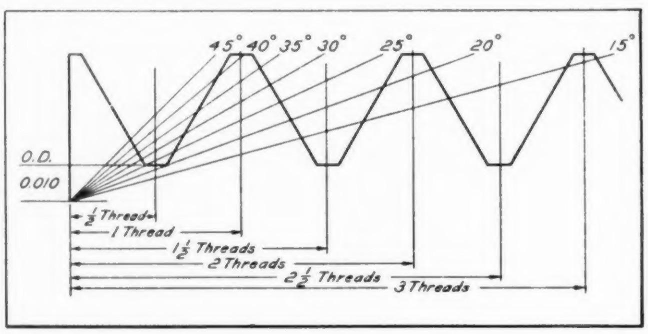


Fig. 1. Number of Threads Chamfered for Different Chamfer Angles

In selecting the material for screws, careful consideration should be given to machinability, as well as to strength. Often a material is specified that has very poor machinability and no advantage in physical properties. There is usually available in each group of steels a grade that has been developed for better machinability. For example, there are free-cutting steels of different carbon contents such as S A E 1112 and 1120, and for still further free-cutting qualities there are X1112 and X1120. In the manganese steel group, there are X1315 and X1335. Then there are the new free-machining leaded steels available in a number of different analyses. Consideration should also be given to the fact that many of the alloy steels do not greatly excel in physical properties unless they are properly heat-treated. By selecting the freest cutting material having the required physical properties, a considerable saving in cost of manufacture and improvement in finish are obtained.

In the stainless steel group, there are special analyses in each range that have been made available for their machining qualities. It is also possible to specify free-machining Monel. The same is true of Dural. In the brasses, it is well to specify "free machining," as the machinability of brass is improved by higher lead content and higher temper or hardness.

Suggestions Relating to Shoulder Threading

It is important to remember that better threads are obtained when the die-head chasers have a reasonable length of chamfer. Fig. 1 shows the number of threads chamfered for different angles or lengths of chamfering. Chamfers of 30 degrees or longer usually will cut a more accurate thread, with a better finish, than shorter chamfers.

When screws must be screwed into tapped holes close to the head, the screw may be necked, as shown in Fig. 2. The neck will not materially

Table 2. American Fine Thread Series Screws and Tapped Holes

All Dimensions in Inches

Thread Size	Basic Dimensions				Pitch Diameter Limits and Tolerances									
					Class 2					Class 3				
	Major Diameter	Basic Depth	Pitch	Basic P.D.	Screws		Tolerance	Tapped Holes		Screws		Tolerance	Tapped Holes	
					Max.	Min.		Min.	Max.	Max.	Min.		Min.	Max.
No. 5-44	0.1250	0.01476	0.02273	0.1102	0.1102	0.1079	0.0023	0.1102	0.1125	0.1102	0.1086	0.0016	0.1102	0.1118
No. 6-40	0.1380	0.01624	0.02500	0.1218	0.1218	0.1194	0.0024	0.1218	0.1242	0.1218	0.1201	0.0017	0.1218	0.1235
No. 8-36	0.1640	0.01804	0.02778	0.1460	0.1460	0.1435	0.0025	0.1460	0.1485	0.1460	0.1442	0.0018	0.1460	0.1478
No. 10-32	0.1900	0.02030	0.03125	0.1697	0.1697	0.1670	0.0027	0.1697	0.1724	0.1697	0.1678	0.0019	0.1697	0.1716
No. 12-28	0.2160	0.02320	0.03571	0.1928	0.1928	0.1897	0.0031	0.1928	0.1959	0.1928	0.1906	0.0022	0.1928	0.1950
1/4-28	0.2500	0.02320	0.03571	0.2268	0.2268	0.2237	0.0031	0.2268	0.2299	0.2268	0.2246	0.0022	0.2268	0.2290
5/16-24	0.3125	0.02706	0.04167	0.2854	0.2854	0.2821	0.0033	0.2854	0.2887	0.2854	0.2830	0.0024	0.2854	0.2878
3/8-24	0.3750	0.02706	0.04167	0.3479	0.3479	0.3446	0.0033	0.3479	0.3512	0.3479	0.3455	0.0024	0.3479	0.3503
7/16-20	0.4375	0.03248	0.05000	0.4050	0.4050	0.4014	0.0036	0.4050	0.4086	0.4050	0.4024	0.0026	0.4050	0.4076
1/2-20	0.5000	0.03248	0.05000	0.4675	0.4675	0.4639	0.0036	0.4675	0.4711	0.4675	0.4649	0.0026	0.4675	0.4701
9/16-18	0.5625	0.03608	0.05556	0.5264	0.5264	0.5223	0.0041	0.5264	0.5305	0.5264	0.5234	0.0030	0.5264	0.5294
5/8-18	0.6250	0.03608	0.05556	0.5889	0.5889	0.5848	0.0041	0.5889	0.5930	0.5889	0.5859	0.0030	0.5889	0.5919
3/4-16	0.7500	0.04059	0.06250	0.7094	0.7094	0.7049	0.0045	0.7094	0.7139	0.7094	0.7062	0.0032	0.7094	0.7126
7/8-14	0.8750	0.04639	0.07143	0.8286	0.8286	0.8237	0.0049	0.8286	0.8335	0.8286	0.8250	0.0036	0.8286	0.8322
1-14	1.0000	0.04639	0.07143	0.9536	0.9536	0.9487	0.0049	0.9536	0.9585	0.9536	0.9500	0.0036	0.9536	0.9572

Note: To find the basic minor diameter of any screw, subtract the basic depth from the basic pitch diameter.—The tolerances on the major diameter for Class 2 and Class 3 fits are twice the pitch diameter tolerances shown for Class 2 fits.—The basic width of flat is one-eighth the pitch.

weaken the screw, because it is cut only slightly below the root diameter. A bevel of 30 degrees on the thread side of the neck, as shown in the illustration, is recommended. The thread will blend better with the neck, not only improving the appearance, but also permitting longer chamfers on the threading tools.

Another way in which to avoid threading close to a shoulder is to counterbore the tapped hole or to use washers. Avoid too deep tapped holes, so as to reduce tap breakage. When tapping blind holes, bear in mind that the tap should have a chamfer of at least from three to five threads, and that it is very costly to tap full threads close to the bottom of the hole.

One of the most aggravating problems in threading special parts is to thread close to a shoulder on materials that do not machine well. Threading close to a shoulder means, of course, a short chamfer on the chasers. A short chamfer, however, will not cut as freely as a long chamfer on materials that are difficult to machine.

If the difficulties in connection with shoulder threading were fully appreciated, it is likely that one of the conditions that cause trouble would be corrected; either a freer machining material would be selected or the design of the part would be changed to permit longer chamfers on the threading tools. Not only is a full thread close to a shoulder objectionable, because of the difficulty involved in obtaining it, but it is also a major cause of tool breakage.

Consider what a threading tool or die-head is required to do. Most of the tools on automatic or hand screw machines are locked in a fixed position and are simply required to produce parts to certain dimensions or tolerances. A threading tool, however, must not only produce pitch diameters within very close tolerances, but the angle on the threads must be maintained within close limits, and the number of turns per inch must also be exact to very close limits at the same time that a good finish is obtained.

With other tools, a definite feed per revolution can be easily established to provide the best finish in a reasonable time, whereas with a threading tool, the feed is governed by the pitch. For example, in cutting a thread having ten threads per inch the feed must be 1/10 inch per revolution.

The Important Subject of Tolerances

Let us now consider the limits and tolerances to be specified. Tables 1 and 2 give the basic dimensions for the American Coarse and Fine Series, and also the tolerances and limits for Class 2 and Class 3 fits for screws and tapped holes. These two classes of fits are described by the American Standards Association as follows:

Class 2 represents a high quality of commercial screw product, and is recommended for the great bulk of interchangeable screw thread work. Class 3 represents an exceptionally high grade of commercially threaded product, and is recommended only in cases where the high cost of precision tools and continual checking of tools and product is warranted.

It often happens that designers, in establishing fits or tolerances, will specify a Class 3 and even a Class 4 fit, for no reason at all, when a Class 2 fit

Fig. 2. Method of Necking Screws that are Screwed into Tapped Holes Close to the Head

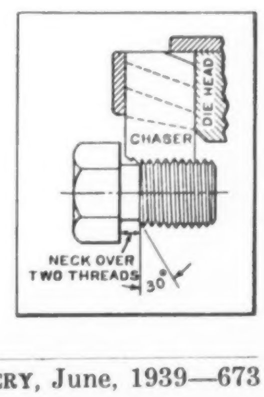
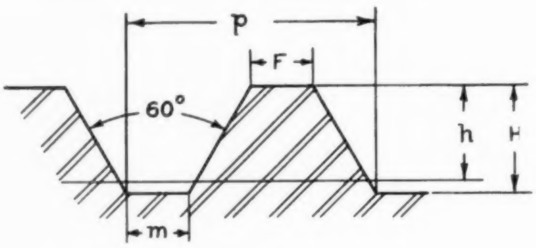


Table 3. Sixty-Degree Stub Threads



p = pitch in inches;
h = basic depth of thread = 0.433 × p;
F = basic width of flat = 0.25 × p;
H = minimum whole depth of thread = 0.453 × p (see note);
m = maximum flat in bottom of screw thread = 0.227 × p.

Threads per Inch	Basic Depth, h	Basic Flat, F	Minimum Whole Depth, H	Maximum Flat in Bottom, m
1	0.4330	0.2500	0.4530	0.2270
2	0.2165	0.1250	0.2265	0.1135
3	0.1443	0.0833	0.1510	0.0757
4	0.1083	0.0625	0.1133	0.0567
5	0.0866	0.0500	0.0906	0.0454
6	0.0722	0.0417	0.0755	0.0378
8	0.0541	0.0313	0.0566	0.0284
10	0.0433	0.0250	0.0453	0.0227
12	0.0361	0.0208	0.0377	0.0189
14	0.0309	0.0179	0.0324	0.0162
16	0.0271	0.0156	0.0283	0.0142

Note: 0.02 p is added to h to produce extra depth, thus avoiding interference with threads of mating nuts. Similar clearance is made in nuts by specifying the major diameter of taps to be larger in the same proportion. Hence, the extra depth is in the bottom of the spaces in screws and on top of the threads in taps.

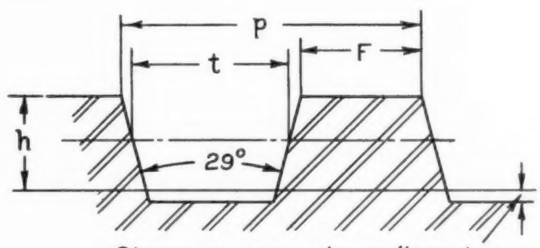
would be perfectly satisfactory and permit economical manufacture.

The tolerances and limits specified for pitch diameter include slight permissible errors in lead or angle of thread, or both. The usual gaging practice on screws is as follows: The "Go" threaded ring gage is set to basic size. If the thread to be gaged is of basic pitch diameter and correct in lead and angle of thread, it will fit the basic ring gage. If, however, there is a slight error in the lead of the screw or a slight error in the form of the threads, the work will not go into the basic ring gage. The threading tool will have to be adjusted very slightly under-size until the screw fits the gage. The tolerances and limits shown in the tables give the amount that it is possible for the thread being gaged to vary from the basic size and still fit a "Go" gage. Fitting the "Go" gage insures interchangeability, while the "No Go" gage checks the amount of pitch diameter change required to secure interchangeability.

Frequently one sees cases where the usual tolerance for a certain class of fit is specified, and yet the depth of engagement or width of the gage may be two or even four times greater than the thickness of a standard gage. In the American-National Coarse Thread and Fine Thread Systems, the tolerances are based on a definite gage thickness. In the case of a 1/2 inch–20, Class 3 fit, the pitch diameter tolerance is specified as 0.0026 inch (see Table 2). If, however, the gage thickness or length of engagement, for some reason, has been increased to 1 inch instead of being the customary thickness, the tolerance should be increased to 0.003 inch.

While the basic dimensions of the U. S. form and the American-National thread are the same, the difference in the two systems is that the gages of the American-National form permit a slight wear on the points of the tools. For example, the minor or root diameter of the American-National "Go" ring gage is made larger than the basic minor diameter by an amount equal to one-sixth of the double depth of the thread. The old U. S. ring gages with basic minor diameter would often cause work to be rejected because of slight wear on the points of the threading tools. However, there was no interference when such screws were actually used in tapped holes, because the size of the tap drill used was larger than the actual minor diameter of the screw. The old U. S. ring gages should be lapped larger at the minor diameter to agree with the American-National gages.

Table 4. Acme Stub Threads



Clearance on minor diameter

p = pitch in inches;
h = basic depth of thread = 0.3 × p;
t = thickness of thread = 0.5 × p;
F = basic flat = 0.4224 × p.

Clearance = 0.010 inch for 10 or less threads per inch
Flat at root = 0.4224 × p — 0.0052 inch

Clearance = 0.005 inch for 11 or more threads per inch
Flat at root = 0.4224 × p — 0.0026 inch

Threads per Inch	Axial Pitch	Basic Depth	Whole Depth
1	1.0000	0.3000	0.3100
2	0.5000	0.1500	0.1600
3	0.3333	0.1000	0.1100
4	0.2500	0.0750	0.0850
5	0.2000	0.0600	0.0700
6	0.1667	0.0500	0.0600
8	0.1250	0.0375	0.0475
10	0.1000	0.0300	0.0400
12	0.0833	0.0250	0.0300
14	0.0714	0.0214	0.0264
16	0.0625	0.0188	0.0238

The illustration above shows a section of the screw. The clearance represents extra depth provided to avoid interference with the threads in the mating nut. Similar clearance is provided in the nut by making the major diameter of the tap over size in the same proportion. For eleven or more threads per inch, 0.005 inch is considered ample clearance, while for ten or less threads per inch, the usual amount for Acme threads, 0.010 inch, is recommended.

Table 5. Recommended Pitches for Given Diameters of Acme Threads

Size, Inch	Threads per Inch	Pitch, Inch	Helix Angle	Size, Inches	Threads per Inch	Pitch, Inch	Helix Angle
1/4	16	0.0625	5°12′	1 1/8	5	0.2000	3°33′
5/16	14	0.0714	4°42′	1 1/4	5	0.2000	3°10′
3/8	12	0.0833	4°33′	1 3/8	5	0.2000	2°52′
7/16	12	0.0833	3°50′	1 1/2	4	0.2500	3°19′
1/2	10	0.1000	4° 3′	1 3/4	4	0.2500	2°48′
5/8	8	0.1250	4° 3′	2	4	0.2500	2°26′
3/4	8	0.1250	3°19′	2 1/2	2	0.5000	4° 1′
7/8	8	0.1250	2°48′	3	2	0.5000	3°19′
1	5	0.2000	4° 3′	4	2	0.5000	2°26′
				5	2	0.5000	1°55′

Threads with So-Called "Fast" Leads

When special thread sizes for some reason seem to be necessary, it is essential to consider the helix angle, because the steeper the helix angle for a given diameter, the greater the power required in threading, and the greater the tendency to produce a poor finish on the thread.

When extremely coarse pitches are used for relatively small diameters, the core diameter of the screw is greatly weakened. The writer has seen screws designed that were so extreme in this direction that the core diameter was too weak to support the strain of the cut.

When a more rapid advance is required in one turn than is provided by standard threads, it is desirable to use multiple threads. For example, if a screw is 1/4 inch in diameter and it is necessary to advance 1/10 inch in one revolution, it would be better to cut twenty threads per inch with a lead of 1/10 inch—that is, to use a double thread that will advance 1/10 inch in one revolution. This finer pitch thread would have less depth of cut and less material to be removed, and would be stronger and have a better finish. The thread would not only be easier to cut, but the hole into which it fits would be easier to tap. A single thread, 1/4 inch in diameter, with ten threads per inch of the American-National form, would have a minor diameter of only 0.120 inch, whereas 1/4 inch diameter with twenty threads per inch, double, would have a minor diameter of 0.185 inch, or over twice the core area and strength.

Translating Threads—Screw Threads Used to Convey Motion

When the purpose of a screw thread is to move a machine part rather than to serve as a fastening means, there are a number of factors that should be considered. If the mass of the part to be moved is relatively small, and there is no serious resistance to the motion, the American-National form of thread is recommended. This form is easy to cut and good fits are easier to control. An excellent modification of the American-National form is the 60-degree stub thread, shown in Table 3. This form is especially advantageous when the pitch is coarse, because it has less depth, and hence a stronger core, and it is simple to cut and tap. The fits are also easy to control.

If a thread with a 14-1/2 degree slope is required, serious consideration should be given to the Acme stub thread, shown in Table 4. The depth is less than that of the regular Acme thread, and hence there is a stronger core, with less metal removed in threading or tapping. This form is preferred to the regular Acme thread when the screw diameter is small.

Table 5 gives recommended diameters and corresponding pitches for standard Acme threads. These diameters and pitches have been chosen to give favorable helix angles. The thread depths and other thread dimensions for Acme threads, as well as the formulas for worm threads, are available in most standard handbooks. [See MACHINERY'S HANDBOOK, Tenth Edition, pages 1283 to 1287.]

The so-called "square thread" should be avoided.

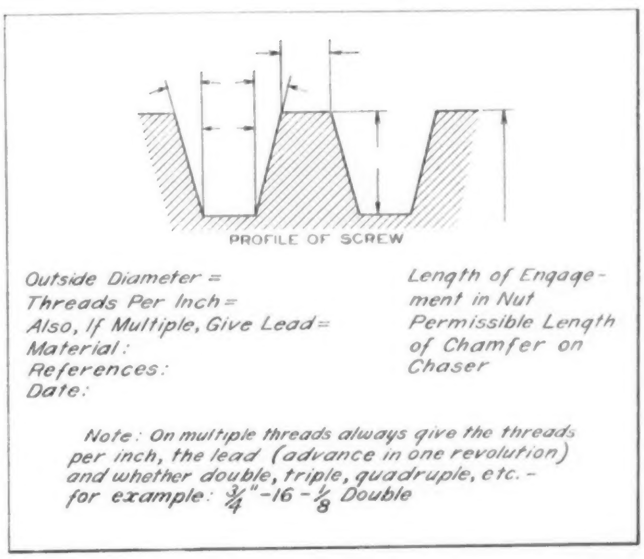


Fig. 3. Information that the Customer Should Give to the Maker of Thread Cutting Tools

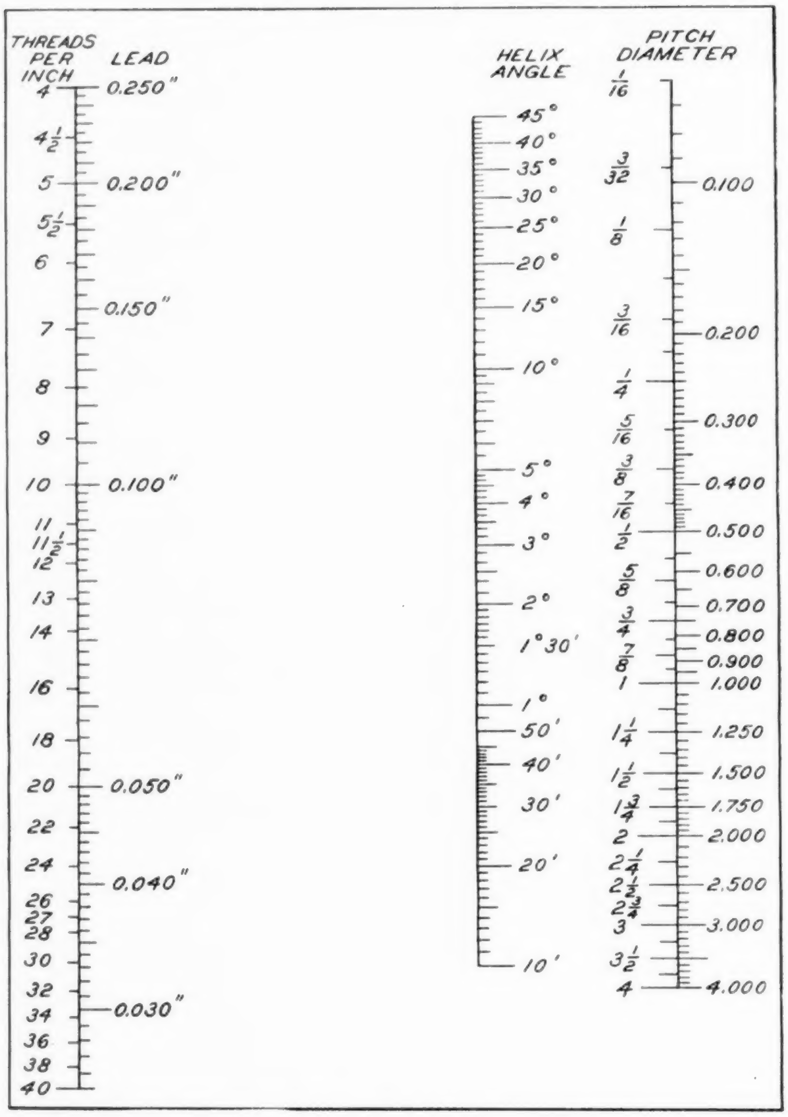


Fig. 4. Chart for Determining Helix Angle of Thread when Lead and Pitch Diameter are Known

Theoretically, the square thread has sides perpendicular to the axis of the screw and has a depth equal to one-half the pitch. Such a thread is very difficult to cut with a die or tap. The metal heats and tends to tear. If a self-opening die-head were used, it probably would not open. Fits between external and internal square thread forms are very difficult to obtain, because no amount of size adjustment has any effect on the fit.

A modification of the square thread has an angle on each side of the thread of 5 or 7 1/2 degrees. When this modification is used, the flat provided at the root or minor diameter of the screw can be made equal to one-half the pitch, so as to prevent interference in the tapped hole.

Summary of Important Suggestions

In designing threaded parts, try to select a standard thread size and form; consider the machinability of the material selected; avoid threading close to a shoulder, especially on material difficult to machine; and do not try to specify closer tolerances than are required by good commercial practice. If a faster lead than is provided by standard threads is required, multiple threads are recommended. If a coarse pitch is essential, consider first the use of 60-degree stub threads, and then the Acme stub thread. Never specify a square thread.

Fig. 3 indicates the information required by the maker of tools for thread cutting. Fig. 4 shows a chart from which the helix angle can be quickly determined when the lead of the thread and the pitch diameter are known. The procedure in finding the helix angle is simple: A straightedge is laid across from the column to the left, which gives the lead and number of threads per inch, to the column at the right, which gives the pitch diameter; then the required angle is read off at the point where the straightedge crosses the "helix angle" column.

Fig. 5. Samples of Parts with Different Types of Special Threads, Used for Various Purposes. Many of the Parts having Such Threads can be Advantageously Made from Stock Already Threaded the Entire Length of the Bar

The Lubrication of Anti-Friction Bearings in Geared Speed Reducers

A Study of the Requirements and Recommendations for the Lubricant to be Used in Anti-Friction Bearings for Gearing, with Especial Reference to Grease Lubrication

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THE lubricant for anti-friction bearings should be selected for the particular application of the bearing. To apply any kind of lubricant, without specific recommendations from reputable refiners, is pure guesswork and might result in short bearing life or complete failure of the bearing. Lubricants for anti-friction bearings must fulfill four distinct functions in order to be satisfactory. These are (1) to minimize friction between the moving parts; (2) to prevent rust or corrosion on the highly polished surfaces; (3) to form a supplementary seal between the rotating shaft and the stationary housing, preventing the entrance of dirt, grit, and foreign matter; and (4) to act as a medium for carrying away and minimizing the heat generated at the bearing.

Operating conditions, such as speed, room temperature, and the humidity of the atmosphere determine what type of grease should be used. For example, if there is danger of moisture or water entering the bearing housing, it is necessary to use a lime-soap grease, or, at least, a grease containing some lime soap (mixed base grease). When a lime-soap grease must be used, it is advisable that this grease have a minimum soap content consistent with the temperature to which it will be exposed.

In general, however, soda-soap greases are preferable to lime-soap greases, as they are mechanically more stable—that is, there is less tendency for the soap to separate from the oil. The principal advantages of soda-soap greases are: (1) They generally have a high melting point and are suitable for operating temperatures up to 200 degrees F. The melting point of lime (calcium) soap greases is seldom as high as 200 degrees F. (2) They do not separate in operation—that is, the oil does not separate from the soap. (3) They are more resistant to oxidation. The oxidation here referred to is the combination of certain ingredients of the grease with the air to form acids, gums, resins, and other harmful substances.

The single disadvantage of soda-soap greases is that they readily mix with water and tend to emulsify when moisture or water is present. For this reason, when there is danger of moisture or water being in the bearing housing, it is necessary to use a lime-soap grease, or a grease containing at least some lime soap (mixed base grease) as mentioned previously. The chief characteristic of lime-soap grease is that it is insoluble in water, and this feature outweighs to some extent the advantages of soda-soap greases for applications exposed to moisture or water. However, even when a lime-soap grease is used, the bearing should be protected from water and moisture insofar as this is possible, as this will increase the life of the bearing.

Different types of greases can be easily identified by placing a small quantity of the grease in water and observing whether it repels the water or mixes with it. A soda-soap grease will dissolve in the water, giving it a cloudy appearance; a lime-soap grease will not mix with the water.

Properties of an Ideal Grease

The properties of an ideal general-purpose anti-friction bearing grease are (1) a melting point of about 300 degrees F. (by the Ubbelohde method); (2) smooth homogeneous (buttery) mixture; (3) freedom from dirt, abrasive, or fillers; (4) low free alkali content; (5) freedom from acid or corrosive matter; (6) minimum free-oil content or tendency to separate in use or storage; (7) maximum resistance to drying, gumming, or oxidizing.

Greases must not contain fillers or foreign matter, such as talc, chalk, pumice, graphite, lead, zinc, sand, asbestos, etc. Regardless of how fine the particles of these foreign substances may be, they should never be used in greases for anti-friction bearings. These greases should be as neutral as possible, free from acid, and with not more than a trace of alkali.

Application of Grease Lubricants

Gear reduction units, when shipped from the factory by responsible manufacturers, have their grease-lubricated anti-friction bearings properly filled with the correct grade of grease, and therefore do not need additional greasing for a period of approximately six months. At that time, a small amount of grease should be added. The ideal con-

dition is for the bearing housing to be from one-third to one-half filled with grease.

Since the shaft extension diameter is generally approximately proportional to the bearing size, the amount of grease to be added should be as follows:

Shaft Extension Diameter, Inches	Weight of Grease to be Added, Ounces
3/4 to 1 1/4	3/4
1 1/4 to 1 7/8	1
1 7/8 to 2 3/8	2
2 3/8	3

One ounce of grease is approximately equal to 1 1/4 cubic inches.

When a surplus grease sump is provided below the bearing, it is desirable to keep this sump emptied at all times.

Regreasing and Maintenance of Bearings

When the bearing housing has been disassembled, the bearings should be protected from grit and dirt. It is recommended that the bearing be wrapped in clean oil paper until it is ready for reassembling. Immediately before reassembly, the bearing should be thoroughly cleaned in a solvent, such as gasoline, kerosene, or banana oil. Then the new grease should be applied over and between the balls or rollers, after first spraying or flushing the bearing with a good grade of lubricating oil.

The grease must be kept in clean containers and applied with a clean paddle. The lid should be kept on the container at all times when not in use. This is very important in order to be assured that the grease is clean. Do not use more than the amount of grease specified in the table, as an over-supply of grease will cause churning, overheating, and grease leakage. If grease leakage occurs, the bearing has been overfilled or the grease used is not suitable for the application. It is good practice to thoroughly clean and regrease a grease-lubricated bearing in ordinary service once every two years. Bearings operating in an atmosphere laden with dust and grit should be thoroughly cleaned at more frequent intervals; and this is also necessary when the operating temperatures are high, as grease decomposes more rapidly at the higher temperatures.

When the operating conditions are unusual, it is especially important that a responsible specialist on grease lubrication be consulted. Such unusual conditions would be (1) operating temperatures below 32 degrees F. or above 200 degrees F.; (2) speeds above 2000 revolutions per minute; (3) the presence of excessive moisture.

Forming Shells by Drawing Metal Both Upward and Downward

By M. J. GOLDSTEIN

SHELLS produced by drawing the metal both upward and downward from the normal level of the sheet material are seldom met with in diemaking practice. When such work is encountered, however, it is quite a problem to lay out dies that will produce shells without wrinkles or breakage. The base of the lamp shown in Fig. 1 and at *C*, Fig. 2, is an example of this kind of work. A cross-section outline of the shell is shown at *D*, Fig. 3. This illustration shows clearly the central hemispherical portion and flange above the normal line of the metal and the intermediate portion below the line. Any attempt to form this piece without first drawing the central spherical portion would only result in broken shells.

The first die used in the production of shell *C*,

Fig. 1. (Left) Lamp with Metal Base Formed by Dies Shown in Fig. 3. Fig. 2. (Below) Three Steps in the Production of Base for Lamp Shown in Fig. 1

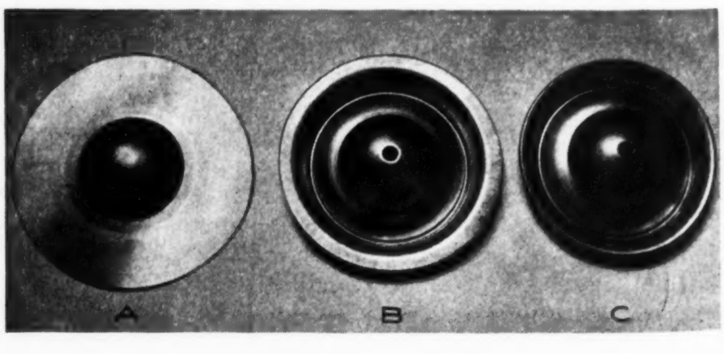

Fig. 2, is shown at *E*, Fig. 3. The punch, cutting ring, and pressure ring of this combination die are of hardened and ground tool steel. In grinding the punch, the face is relieved, so that less pressure is exerted at the flange of the shell than at the drawing edge. This is of great help in drawing the spherical part of the shell, since this part is 2 1/2 inches in diameter and the blank is 6 1/4 inches in diameter. The shell is made in both brass and steel, 24-gage (0.020 inch) metal being used.

Both the die and punch have air vents, and it will be noted that no knock-out is used in this die, since the drawn shell will not stick in the punch member. Pressure on the blank is exerted by a rubber spring barrel 4 inches in diameter by 8 inches long. The shell, as it comes from this die, is shown at *A*, Fig. 2.

For the second operation, the shell is turned upside down, the die being made to handle the shell in this position. The die used for this operation is shown at *F*, Fig. 3. The pressure ring and punch are of tool steel and are left soft, as the finish-forming of the shell imposes no heavy duty on these parts. The forming block is cold-rolled steel, and has a tool-steel die inserted for punching the center hole at the end of the stroke. The punch for this perforating die is held in the punch-holder and the stripper does double duty, since it acts to centralize the shell before the flange is gripped between the punch and the pressure ring.

The stripper also maintains the proper depth of the central spherical part of the shell, as the stripper moves upward until its rear portion touches the cast-iron punch-holder. Two 1/4-inch drill-rod pins pass through the punch-holder and serve as knock-out pins for stripping the shell from the punch. The finish-formed shell is shown at *B*, Fig. 2, and the die is shown in Fig. 4.

Fig. 4. Punch and Die Members of Forming Die Shown at F, Fig. 3

The finishing operation is performed on a trimming and beading lathe. It consists of trimming the edge to remove any irregularities and rolling or wiring the edge. A wooden chuck formed to fit the contour of the shell is held on the threaded nose-piece of the lathe and a flat round block is held on a ball-bearing chuck. By means of a lever and fixed cam, pressure is applied to the shell, so that it rotates with the chuck, which runs at a speed of 1000 revolutions per minute.

A table which holds the trimming tool at the front and the beading roller at the rear of the work is actuated by a lever movement. Adjustable stops regulate the movement of the table. An upward movement of the lever causes the tool at the front of the table to advance and trim the shell, and a downward movement of the lever brings the roll at the rear of the table into position to curl the edge of the shell. The curling or beading operation gives the shell a smooth finish, as shown at *C*, Fig. 2. This completes the shell, ready for assembling.

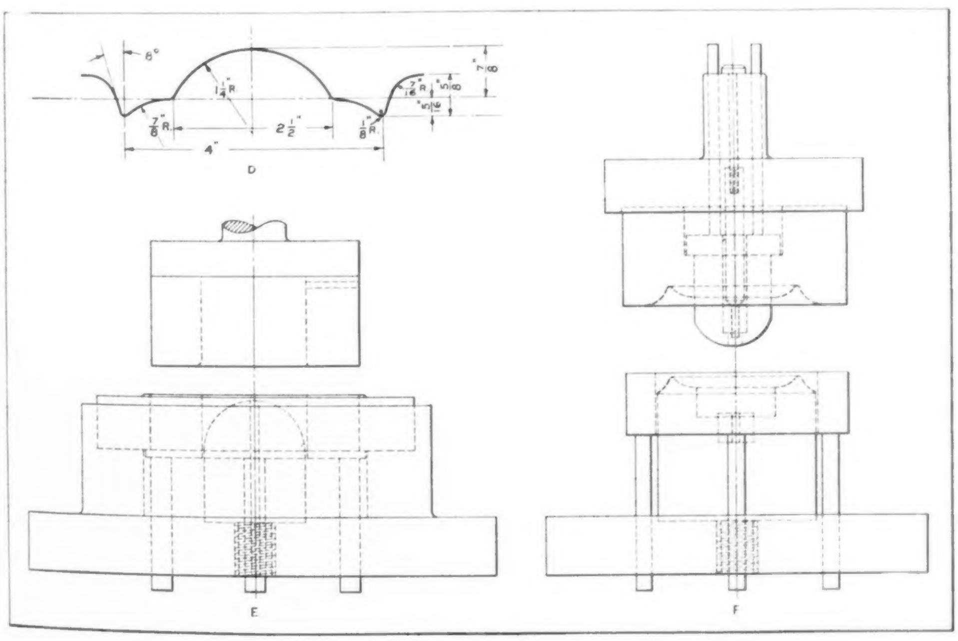

Fig. 3. (D) Cross-section of Lamp Base; (E) Die Used to Blank and Form Shell A, Fig. 2; (F) Second-operation Forming Die that Produces Work Shown at B, Fig. 2

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For every dollar in dividends paid by the railroads to their owners during the five-year period 1933 to 1937, federal, state, and local governments took $1.98 in taxes from the railroads—approximately twice as much as the owners of the roads obtained for the use of their money in building and equipping the roads. Are we to believe that the benefits and services rendered by the Government to the railroads were worth that much? For Government, like anybody else, is entitled only to collect the equivalent of service rendered.

Determining Time Required for Hobbing Gears

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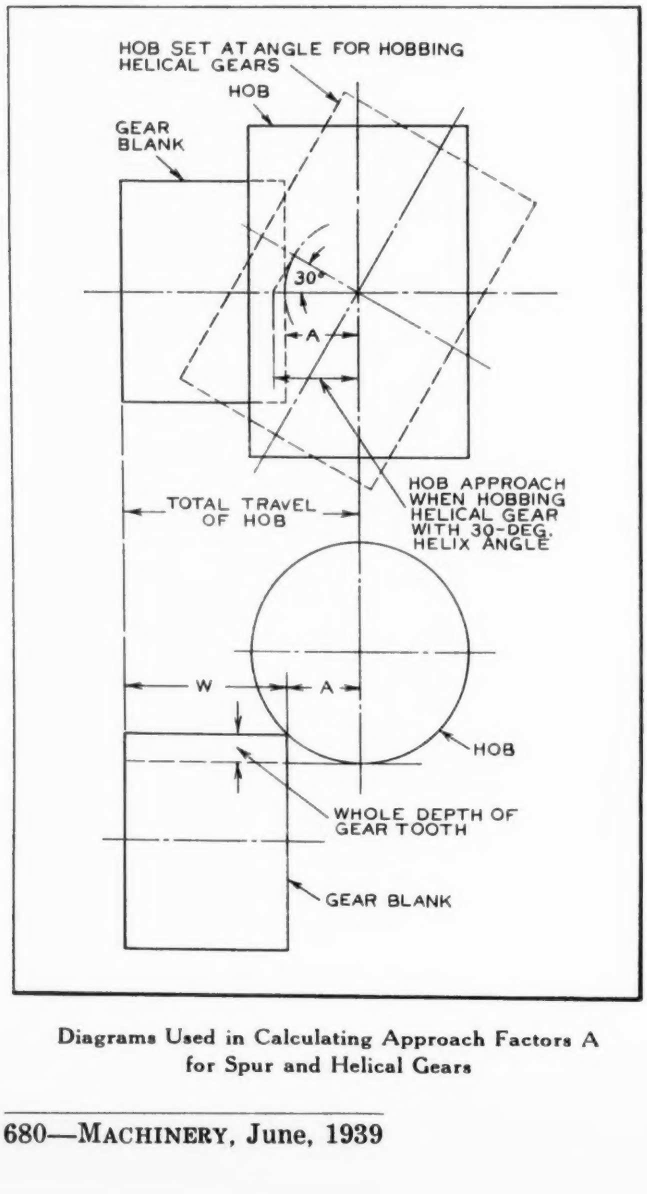
IN jobbing shops and in shops where piece-work or incentive systems, such as the Bedaux system, are in use, it is often necessary to calculate the time required to hob a gear or spline shaft. After determining the proper speeds and feeds, it is a comparatively easy matter to calculate the time T required for hobbing a gear by using the formula

$$T = \frac{N \times t}{F \times \text{R.P.M.}}$$

in which

N = number of teeth in gear;
t = total travel of hob, in inches;
F = feed of hob per revolution of blank;
R.P.M. = revolutions per minute of hob.

The values for N, F, and R.P.M. are determined very easily and are usually given. The value of t, which equals the width of the gear blank face plus the hob approach, indicated at A in the diagram, is not obtained so readily. In order to simplify the problem of determining the hob approach A, the writer compiled the accompanying table, in which the hob approach A for a spur gear equals one-half the length of the chord of a circle having a diameter equal to the diameter of the hob and a height equal to the whole depth of the gear tooth.



Diagrams Used in Calculating Approach Factors A for Spur and Helical Gears

For helical gears, the hob approach varies according to the helix angle, increasing as the helix angle increases. For example, a spur gear of 4 diametral pitch has an approach value A of 0.887, according to the table, whereas the approach value A for a helical gear of the same diametral pitch but with a helix angle of 30 degrees is 1 inch. The reason for the greater approach required for the helical gear is indicated diagrammatically in the illustration. It will be evident that the hob approach for a helical gear is equal to the approach A for a spur gear divided by the cosine of the helix angle of the helical gear, assuming, of course, that the helical gear and the spur gear are of the same diametral pitch and that the hobs used for both gears are of the same diameter.

In using a hob 2 inches in diameter for a spur gear of 20 diametral pitch, the hob approach, according to the table is 0.454 inch. Using a hob 2 1/2 inches in diameter, the hob approach would equal

$$A \times R = 0.454 \times 1.25 = 0.568 \text{ inch}$$

Now, assuming that

T = cutting time, in minutes;
N = number of teeth in gear;
W = face width of gear, in inches;
A = cutter approach, in inches;
F = feed per revolution of blank, in inches; and
R.P.M. = revolutions of cutter per minute;

$$T = \frac{N \times (W + A)}{F \times \text{R.P.M.}}$$

This formula can now be used to obtain the cutting time, taking the hob approach value A from the accompanying table. For example, assume that we have a spur gear in which $N = 20$; $W = 1.5$; diametral pitch = 16; $F = 0.015$; R.P.M. = 200; and hob diameter = 1.5 inches. From the table, we find that the approach value A for a spur gear of 16 diametral pitch, when using a hob having a radius of 1 inch, equals 0.500 inch. As the hob used in this case has a diameter of 1.5 inches, we have:

$$A = 0.75 \times 0.500 = 0.375$$

Now, substituting numerical values in the formula for T, we have

Cutter Approach Factors for Determining Time Required for Hobbing Gears

Diametral Pitch	Circular Pitch	Cutter Approach Factor for Hob Having Radius of 1 Inch*									
		Spur Gear	Helix Angles of Helical Gears, Degrees								
			10	20	30	35	40	45	50	55	60
4	0.7854	0.887	0.900	0.943	1.000	1.080	1.160	1.250	1.380	1.550	1.770
5	0.6283	0.824	0.838	0.877	0.952	1.010	1.080	1.170	1.280	1.440	1.650
6	0.5236	0.770	0.782	0.828	0.890	0.940	1.010	1.090	1.200	1.330	1.540
7	0.4488	0.720	0.732	0.766	0.831	0.879	0.940	1.020	1.120	1.260	1.440
8	0.3927	0.685	0.695	0.730	0.802	0.836	0.895	0.980	1.070	1.190	1.370
9	0.3491	0.650	0.660	0.692	0.750	0.794	0.850	0.920	1.010	1.130	1.300
10	0.3142	0.620	0.629	0.660	0.716	0.757	0.810	0.877	0.965	1.080	1.240
11	0.2856	0.595	0.604	0.633	0.687	0.726	0.778	0.842	0.925	1.040	1.190
12	0.2618	0.572	0.580	0.608	0.661	0.696	0.748	0.809	0.890	0.998	1.140
13	0.2417	0.552	0.559	0.587	0.637	0.673	0.721	0.786	0.860	0.961	1.100
14	0.2244	0.534	0.542	0.568	0.618	0.652	0.698	0.755	0.832	0.932	1.070
15	0.2094	0.517	0.525	0.550	0.597	0.632	0.675	0.732	0.803	0.903	1.030
16	0.1963	0.500	0.508	0.532	0.577	0.611	0.653	0.707	0.778	0.873	1.000
17	0.1848	0.485	0.492	0.516	0.560	0.592	0.635	0.686	0.754	0.846	0.970
18	0.1745	0.472	0.479	0.502	0.544	0.576	0.618	0.668	0.733	0.823	0.944
19	0.1653	0.462	0.469	0.490	0.533	0.562	0.603	0.654	0.717	0.806	0.924
20	0.1571	0.454	0.461	0.483	0.525	0.554	0.593	0.642	0.706	0.792	0.908
22	0.1428	0.431	0.437	0.458	0.497	0.526	0.563	0.608	0.672	0.754	0.862
24	0.1309	0.414	0.421	0.441	0.478	0.506	0.540	0.585	0.644	0.723	0.828
26	0.1208	0.398	0.404	0.423	0.460	0.486	0.520	0.562	0.619	0.694	0.796
28	0.1122	0.385	0.391	0.410	0.445	0.470	0.503	0.545	0.600	0.672	0.770
30	0.1047	0.373	0.379	0.397	0.431	0.455	0.487	0.527	0.581	0.651	0.746
32	0.0982	0.362	0.368	0.385	0.418	0.442	0.473	0.512	0.563	0.632	0.724
34	0.0924	0.350	0.356	0.372	0.404	0.427	0.457	0.495	0.545	0.610	0.700
36	0.0873	0.342	0.347	0.364	0.395	0.418	0.446	0.483	0.532	0.597	0.684
38	0.0827	0.334	0.339	0.355	0.386	0.408	0.436	0.472	0.520	0.573	0.668
40	0.0785	0.325	0.330	0.346	0.375	0.396	0.425	0.460	0.506	0.567	0.650
42	0.0748	0.317	0.322	0.337	0.366	0.387	0.415	0.448	0.493	0.552	0.634
44	0.0714	0.309	0.314	0.328	0.357	0.377	0.404	0.437	0.481	0.538	0.618
46	0.0683	0.302	0.307	0.321	0.349	0.369	0.394	0.427	0.470	0.527	0.604
48	0.0654	0.296	0.301	0.315	0.342	0.361	0.387	0.418	0.460	0.517	0.592
50	0.0628	0.292	0.296	0.310	0.337	0.356	0.381	0.413	0.454	0.509	0.584
56	0.0561	0.275	0.279	0.292	0.318	0.336	0.359	0.390	0.428	0.480	0.550
60	0.0524	0.262	0.266	0.279	0.303	0.320	0.342	0.371	0.407	0.458	0.524

*To find cutter approach factor for hob having radius other than 1 inch, multiply value in table by given radius.

$$T = \frac{20 \times (1.5 + 0.375)}{0.015 \times 200} = 12.5 \text{ minutes}$$

In the case of a helical gear, in which $N = 30$, $W = 1$ inch, diametral pitch $= 20$, $F = 0.010$ inch, R.P.M. $= 250$, helix angle of gear $= 19$ degrees 45 minutes, and hob diameter $= 1.875$ inches, the cutter approach factor A is:

$$A = 0.9375 \times 0.483 = 0.4528$$

Now, substituting this value for A and the other numerical values in the formula for T, we have:

$$T = \frac{30 \times (1 + 0.4528)}{0.010 \times 250} = 17.5 \text{ minutes approximately}$$

Japan Doubles Machine Tool Imports in 1938

The Japanese imports of metal-working machinery from the United States, United Kingdom, Germany, and Switzerland, the principal countries from which Japan bought such machinery in 1938, were valued in that year at over $35,500,000, as compared with slightly less than $17,500,000 in 1937, an increase of 104 per cent, according to figures published by the Machinery Division, Department of Commerce, Washington, D. C. The imports in 1938 were about six and one-half times those for 1935, which were valued at $5,360,000.

The United States was the principal source of the imports of metal-working machinery into Japan in 1938, accounting for approximately $23,800,000 of the total value. This is the highest value for imports of metal-working machinery from the United States to Japan for any year on record. It is quite possible that the imports from the United States may be even greater in 1939, because at present they are running at a rate of over $2,000,000 per month.

The exports from Germany to Japan were valued at $9,440,000 in 1938 as compared with $3,790,000 in 1937. In 1934, Germany was the principal supplier of metal-working machinery to Japan, but domestic requirements have so occupied German manufacturers of late that the competition of Germany with the United States in the Japanese market has been less severe. The United Kingdom almost doubled its metal-working machinery exports to Japan in 1938.

Machining Cylinder Barrels for

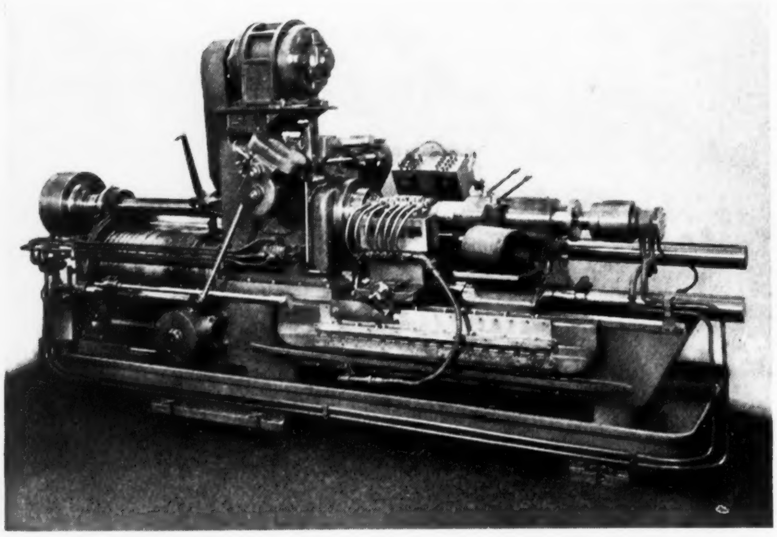


Fig. 1. Rough-turning the Outside of Forged 0.40 Per Cent Carbon Chrome-molybdenum Steel Airplane Engine Cylinder Barrels, Having a Maximum Hardness of 187 Brinell, on a Fay Automatic Lathe. Length of the Barrel is 11 Inches; Outside Diameter, 8 5/8 Inches; and Forged Hole Diameter, 5 3/4 Inches

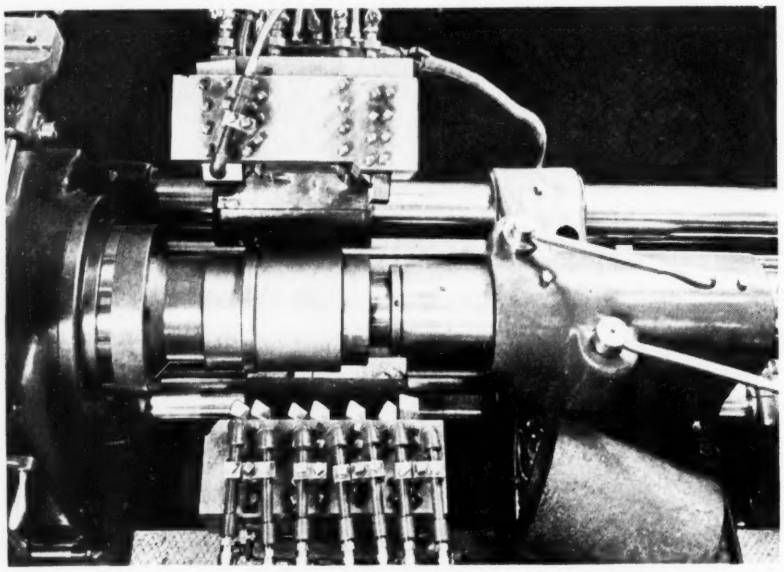


Fig. 2. Close-up View, Showing Cylinder Barrel Mounted Between the Hydraulically Operated Internally Gripping Headstock and Tailstock Fixtures Used in the Set-up Shown in Fig. 1

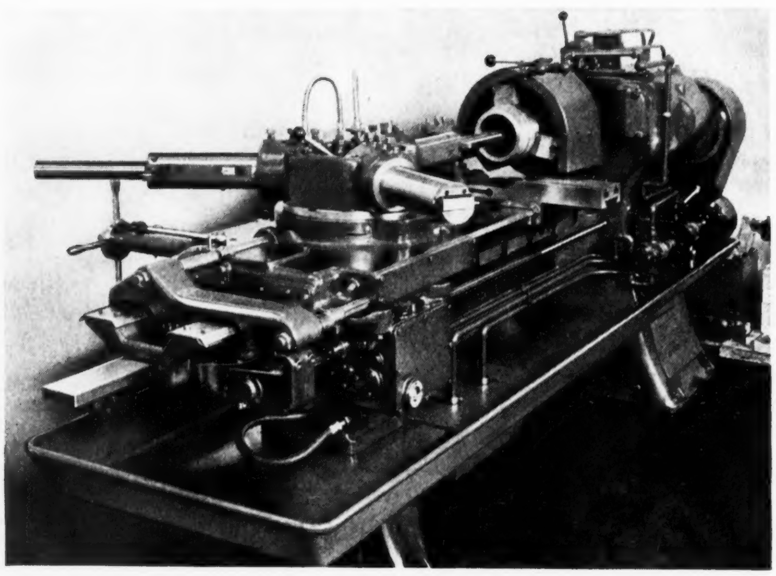


Fig. 3. The Next Operation on the Barrels Consists of Rough-boring, Facing the Rough End, and Chamfering Both Ends on a Jones & Lamson Universal Turret Lathe Equipped as Shown

Air-Cooled Airplane Engines

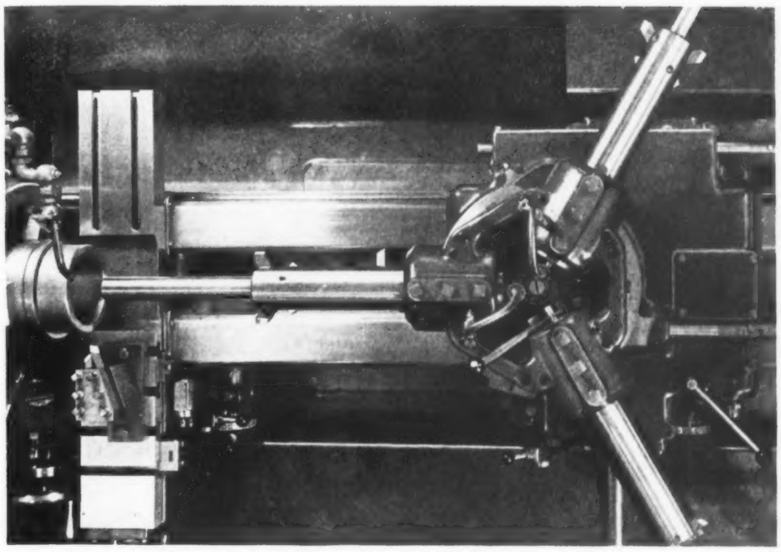


Fig. 4. Close-up View of Turret and Cross-slide Tools, Used for Operation Performed on the Machine Shown in Fig. 3, which is Equipped with a Hydraulically Operated Three-jaw Chuck. The Next Operation Consists of Normalizing the Forging in Preparation for the Finishing Operation Shown in Fig. 5

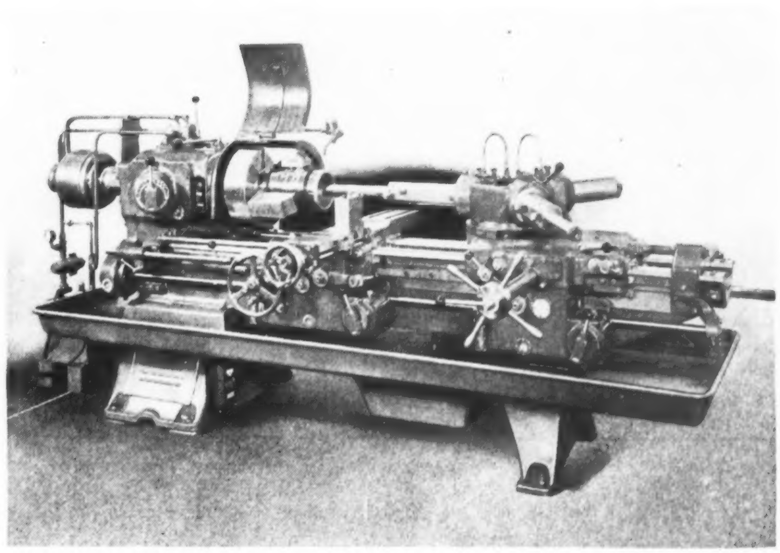


Fig. 5. Universal Turret Lathe Equipped for the Next Operation, in which the Cylinder Barrels are Finish-bored and Chamfered, and Finish-faced on the Crankcase End after Normalizing

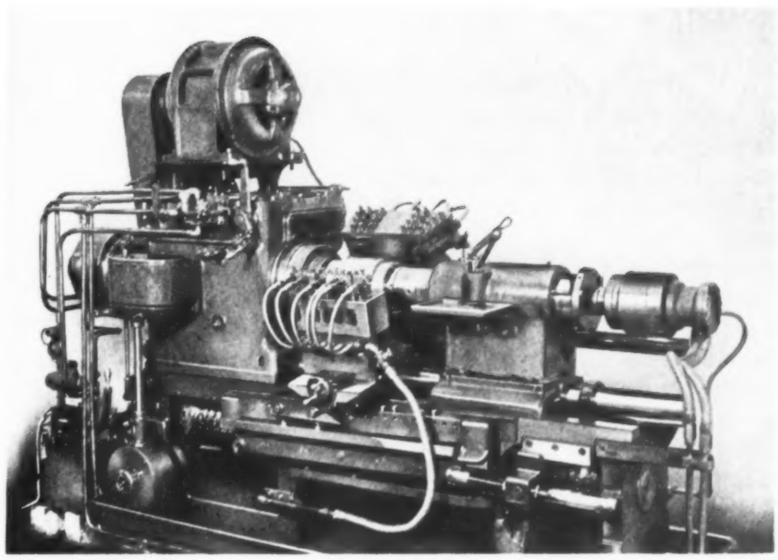


Fig. 6. Machine Equipped for Semi-finish-turning the Outside and Facing the Head End of the Cylinder Barrel, Using Hydraulically Operated Headstock and Tailstock Fixtures

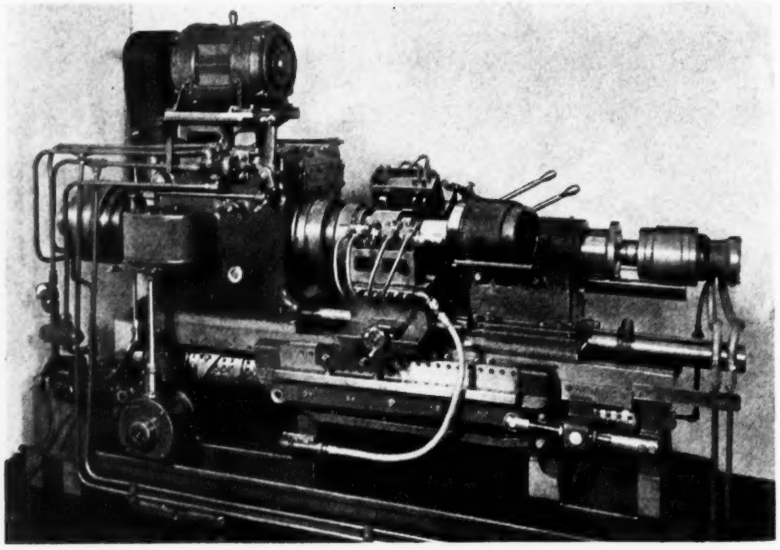


Fig. 7. After the Nitriding of the Bore and the Performing of Two Grinding Operations, the Outside Diameter is Semi-finish-turned, Using the Driving Ring to Engage the Headstock Fixture

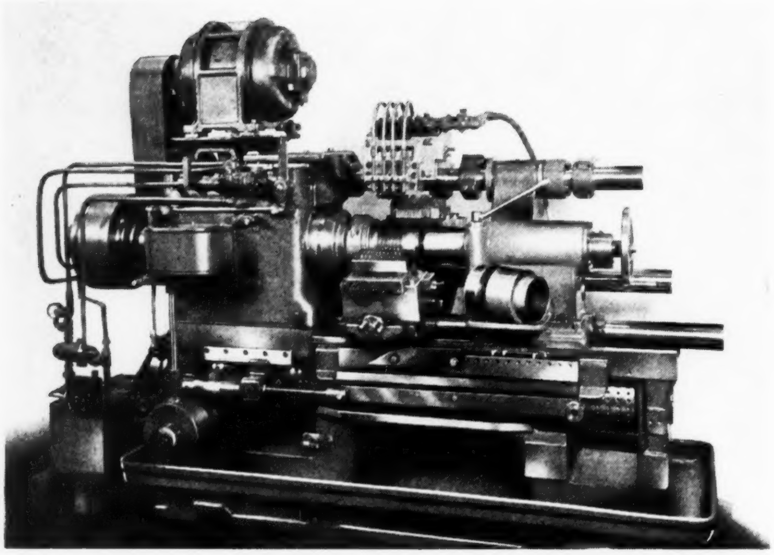


Fig. 8. After Finish-turning the Outside Diameter of the Barrel on a Fay Automatic (Not Shown), the Cooling Fins on the Cylinder Barrel are Machined as Indicated in This Illustration

Prominent Industrialist Urges End of Government by Minorities

ADDRESSING the Cincinnati Chamber of Commerce at its one-hundredth anniversary celebration, A. W. Robertson, chairman of the board of the Westinghouse Electric & Mfg. Co., said: "The time has come when we must face our problems as citizens of the whole country, and not as members of minorities. As citizens of our country we shall not be guilty of pulling strings and log-rolling, which result in a literally endless amount of legislation and schemes in favor of small minorities, to the disadvantage of the country as a whole. The tremendous increase in taxes during recent years has been caused almost entirely by efforts to meet the demands of minorities. The foolish schemes that we have tried or listened to are all brain children of minorities.

"An analysis of most of our proposed changes," he continued, "will disclose that they spring from minority pressure groups, who desire some advantage for themselves, which must be paid for by the rest of the world. The minority point of view results in endless demands on the Government for special privileges, which raise governmental expense on all hands.

"The result of these demands from pressure groups is confusion and conflict. We find the Government restricting agricultural products, and at the same time, spending large sums of money to bring more land under cultivation. It appoints commissions and directs its attention to giving employment to the older worker, and at the same time, discovers severe restrictions in its own bureaus.

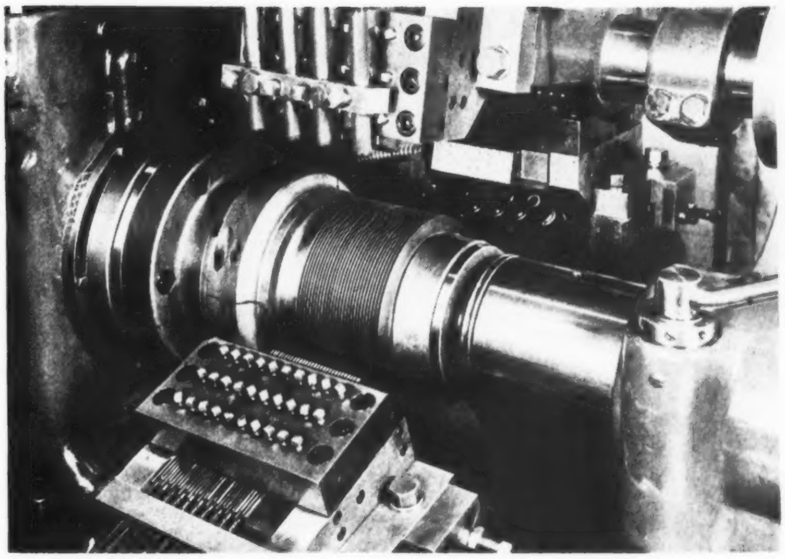


Fig. 9. Close-up View of Set-up on Machine Shown in Fig. 8. This View Shows the Three Banks of Tools Used to Turn the Cooling Fins, and the Drive Ring that Engages Headstock Fixture

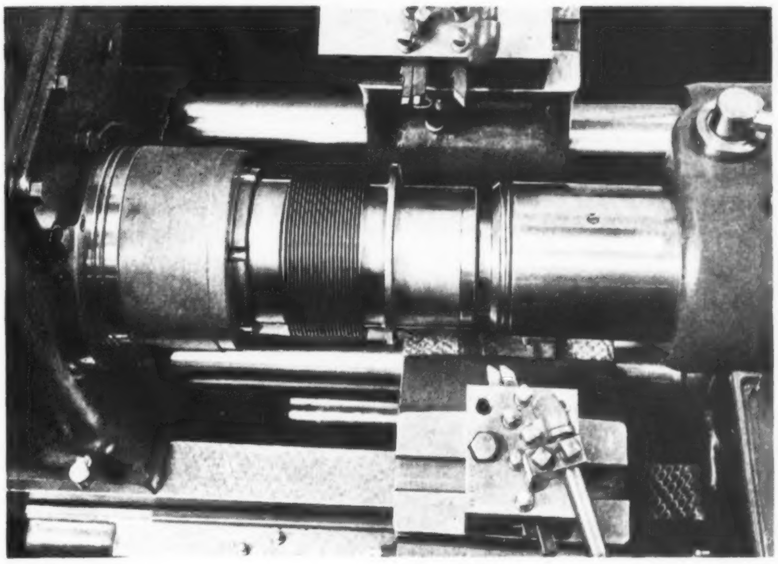


Fig. 10. Set-up for the Final Operation on the Cylinder Barrel, which Consists of Finish-turning the End of the Cylinder Below the Flange, and Facing One Side of the Flange

"Government is so used to its own contradictions, it never even stops to explain them. We are told one minute there will be no increase in taxes, and the next minute they are increased; or that the budget is about to be balanced, and the next minute it is thrown further out of balance. To heap confusion on confusion, the tendency is not only to be governed by minorities, but also to blame minorities for all our troubles. Practically every group of citizens has been blamed for our discontent and unhappy lot—bankers, lawyers, public utilities, manufacturers, and others.

"Industry has been blamed for unemployment, and we are urged to increase both employment and wages, even though we are now spending, as a report of the U. S. Department of Commerce discloses, 84 cents for wages out of every dollar applicable to wages, taxes, interest, and dividends. Just how industry could hire many more people or increase wages very much out of the 16 cents left to pay taxes, dividends, and interest is, of course, not disclosed."

Mr. Robertson suggested that one of the first things citizens should concern themselves with is whether people on relief should have the right to vote. "If they lost this right," he said, "when they went on relief they would have a tremendous incentive to get off relief in order to regain the right of citizenship. At present, a person on relief has little incentive to get off. He is both judge and advocate. As a citizen he decides the case in his own favor." He pointed out that the framers of the Constitution recognized that those who are dependent upon the Government should not have the right of franchise when they provided that citizens of the District of Columbia should have no right to vote.

He also stated that the modern practice of borrowing money to live on is "a cowardly way of pushing our burdens on the shoulders of our children. It started as an emergency measure, but is fast becoming a custom that will be difficult to stop, short of bankruptcy. Forty billions of national debt, plus the state and municipal debts, is an appalling burden and it never stops growing."

Engineering News Flashes

The World Over

The Great McDonald Observatory and Telescope Completed

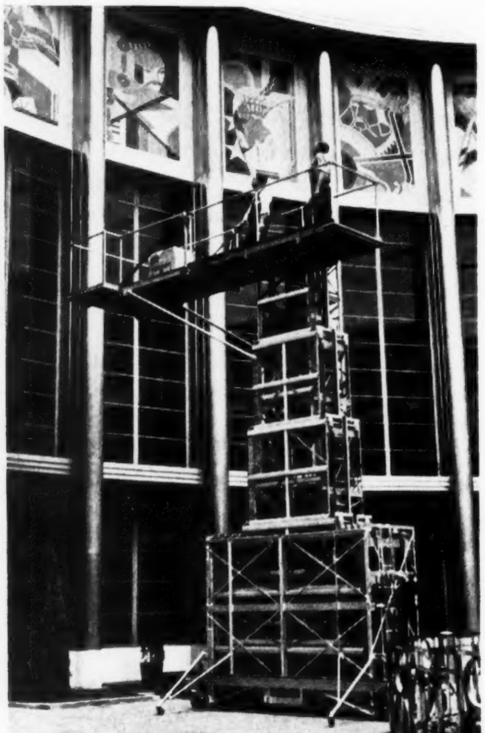
The McDonald Observatory with its mammoth 82-inch reflecting telescope, to be operated jointly by the University of Texas and the University of Chicago, was formally dedicated on May 5. It is located at a height of 6800 feet above sea level on the top of Mount Locke in western Texas. Here the astronomers have the advantage of a clear sky nearly 80 per cent of the time. The nearest village is 16 miles away, and the nearest railroad 42 miles.

The design and construction of the observatory and telescope were carried out by the Warner & Swasey Co., Cleveland, Ohio. As an indication of the size and power of the telescope, photographs can be taken with its aid of stars that are one million times fainter than the faintest star that can be seen with the unaided eye. Some of these stars are 400,000,000 light-years from the earth. To compute the distance equivalent to one light-year, multiply 186,000 (the number of miles that light travels per second) by 32,000,000, the approximate number of seconds in a year. It is estimated that, were it possible to obtain a level surface for such a distance, the new reflector type telescope could distinguish the image of a man at a distance of 3000 miles.

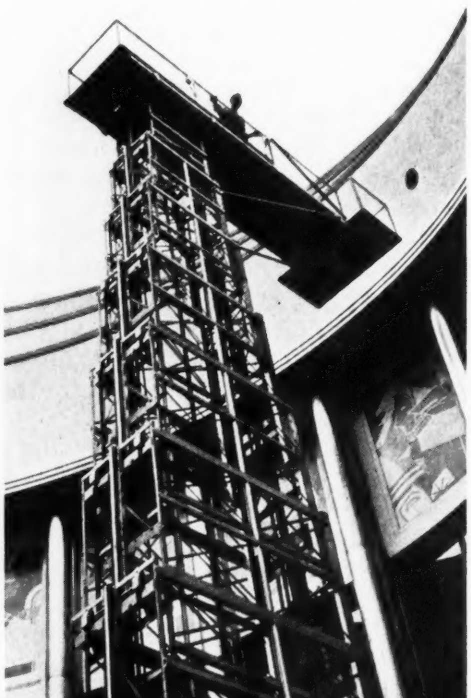
The 82-inch mirror which is part of the telescope is 13 inches thick and weighs nearly 6000 pounds. It was cast of Pyrex glass by the Corning Glass Works December 31, 1933. After cooling for several months, it was brought to the optical department of the Warner & Swasey Co. for grinding, polishing, and aluminizing. Special laboratories, grinding and polishing machinery, and scientific testing apparatus had to be installed to finish the giant mirror. So carefully is the 26-foot, 75-ton telescope mounted and balanced that it only takes a 1/3-H.P. motor to move it.

New Controls for Variable-Pitch Propellers

In order to make flying safer by enabling airplanes to take off from smaller fields, Nicholaas E. Groeneveld Meijer, of the General Electric Co., has



Among interesting engineering constructions may be classed the "Hi-Reach" platform telescoper built by the Economy Engineering Co., Chicago, Ill., for the Ford Motor Co., Dearborn, Mich. This is a motor-driven portable platform elevator which rises in a jack-in-the-box style from a minimum height of less than 9 feet to a height of 46 feet above the floor. It carries a platform 17 feet long. This device is used to keep the ceilings and windows clean in the Ford Rotunda Building in Chicago.



developed a new type of variable-pitch propeller. The mechanism of this propeller is enclosed in the hub, and the change in pitch is effected by heat, generated by an electric coil. The heat causes metallic cylinders, telescoped within one another, to expand. These sleeves are connected to the pitch-changing mechanism. The coil heats the cylinders when the current is applied by the pilot from a switch in the cockpit. As the sleeves are heated, they tend to expand and slide out of one another. This movement operates the pitch-controlling mechanism which adjusts the blades. The amount of heat used to expand the sleeves is controllable, so that any desired pitch can be obtained. Cold air is used to cool the cylinders so as to contract them.

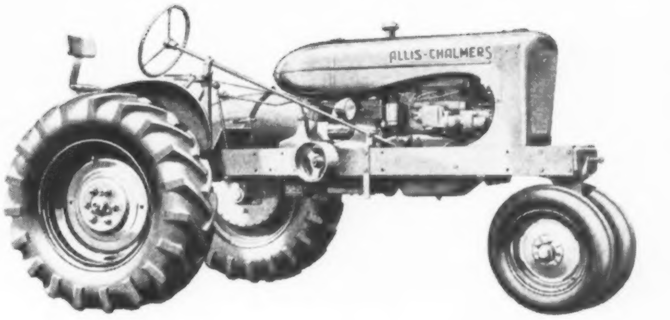
Another device patented by Mr. Meijer for changing the pitch consists of a metal bellows filled with a liquid which has a high coefficient of expansion. A hermetically sealed heating element is inserted in the bellows, and by heating the element, the liquid expands and thereby expands the bellows. This, in turn, exerts the force necessary to change the pitch of the blades.

A third arrangement utilizes the exhaust gases as a source of heat to operate the pitch-changing mechanism instead of electric heater coils. This provides for an inexpensive, completely controllable variable-pitch propeller for small planes. Exhaust gases are conducted from the motor to the expansion elements of the mechanism. A three-way valve admits gas, cold air, or any desired mixture of the two, to the expansion unit of the propeller. The valve setting, which can also be controlled automatically, then determines the pitch of the blades.

New Method of Armature Winding Saves Thousands of Dollars a Year

The discovery of a new principle in armature winding that will save manufacturers of electrical equipment thousands of dollars a year has been announced by two members of the staff of the School of Electrical Engineering at Cornell University, Professor M. G. Malti and Dr. Fritz Herzog, research associate. In the past, manufacturers of electrical motors and generators have had to make a different die for cutting slots in the armature of each separate type of machine, because of the method used in winding the armatures. This has made such equipment expensive, as the cost of these dies is very high, often running from $5000 to $20,000 each.

With the new method of winding armatures, the same slot die can be used for numerous different types of machines, thus distributing the cost of the die over several machines and saving thousands of dollars. The details will be described in a paper to be presented at the convention of the American Institute of Electrical Engineers this month.



An Allis-Chalmers Tractor with Balloon Tires Partially Filled with a Heavy Ballast-weight Liquid

Tractor Tires Partially Filled with a Heavy Liquid

For use on its tractors, the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has developed what are known as Hydromatic tires. These are balloon tires which, instead of being entirely filled with air, are about three-fourths filled with a freeze-resistant liquid. The remaining space is filled with air, so that the desired pressure can be maintained in the tire. The liquid is a mixture of 15 per cent calcium chloride and 85 per cent water, having a specific gravity of 1.14. This mixture will not freeze at the temperature that water will. It will form a slush at 10 degrees F. above zero, but will not freeze to a solid even at 20 degrees below zero, and no harm will be done to the tires even at lower temperatures.

The liquid, being heavier than water, supplies the weight formerly provided by means of wheel weights. It is easier to add or remove than the heavy wheel weights formerly used.

It is claimed that the liquid tire ballast results in smoother wheel rotation, better traction, and steadier action in the entire tractor. Furthermore, the weight added inside the tire offers no unsightly projections on the wheels. An additional advantage is that the ballast liquid is inexpensive. It is easily pumped through the regular tire valve and removed in the same manner. The calcium chloride in the liquid will not harm the casings, tubes, or valves.

Progress in the Construction of Rapid Transit Cars

A series of new rubber-sprung aluminum-bodied rapid transit cars has been added to the equipment of the Brooklyn-Manhattan Transit System in New York. The new cars, built by the Clark Equipment Co., Battle Creek, Mich., use eight 720-H.P. General Electric motors for each train unit. Twice as much horsepower per pound of material is developed as in the conventional type of car. The motors are capable of accelerating the train to a speed of over 20 miles an hour in six seconds.

EDITORIAL COMMENT

The spread of misinformation and malicious propaganda about industry and business has brought about the acceptance of an amazing crop of erroneous ideas in the minds of great numbers of industrial workers. There is no more important job facing industry today than to correct this condition of affairs. The place to start is right in one's own organization.

Telling the Workers the Industrial Facts of Life

Some manufacturers used to believe in the comfortable old theory that a good product sold itself. It is pretty generally agreed now that, no matter how ingenious the design or how fine the workmanship, the facts about a product have to be told or they will not be known. This applies with equal force to the industrial facts of life; and the job of telling his own men is squarely up to every industrial executive. Some of these facts seem so obvious that they hardly need to be stated. Perhaps that is why they have been so largely neglected. By way of illustration, let us cite a few instances.

To any practical-minded person it seems self-evident that in order for a nation to consume more—that is, to live better—it must first produce a larger supply of the goods to be consumed. Yet, not only do many men in industry believe the contrary to be true, but some of our national policies have been, and are being, shaped by men who fail to recognize this simple truth.

False Ideas Harmful to Industry Hurt the Worker Too

Most industrial workers do not realize that their interests are in any way affected by the punitive and needlessly restrictive measures recently imposed upon business by federal legislation. But the fact is that their very jobs are endangered by such measures. Oppressive regulations which prevent industry from operating at a profit mean that many plants will have to curtail production, and some will be shut down entirely, with a resultant destruction of jobs.

A tax policy designed to "soak the rich" is not supposed to touch the pocketbooks of working people. But the fact is that everyone pays these taxes indirectly in the higher prices of the necessities and comforts of life that he buys. For example, on every gallon of gas burned getting to and from the job, the cost is increased not only by an average of 5 cents in direct federal and state taxes paid by the consumer, but also by the taxes levied on the gasoline producer and distributor, estimated to add 4 cents per gallon. This makes 9 cents of tax in all, for every gallon of gasoline.

The average shop man thinks that the millions of government employes are no concern of his, because these people are paid by the Government, which apparently has an unlimited supply of money. But the fact is that these millions of non-producing government office-holders must be supported by the efforts of the men who are producing food and goods. How many realize that for every six workers in industry there is one government employe to be supported—that six producers must share the results of their work with one non-producer? Whoever foots the salary bill, the net result is that every worker must give up $5 of every $35 in his pay envelope to support the non-producing government employe.

Giving the Correct Information Begins at Home

One of the most popular delusions of the day is that efficient shop equipment reduces jobs. The fact is that the whole history of industrial development offers proof to the contrary. Many more jobs have been created by inventions and improved mechanical equipment than have been destroyed. It is also a fact that since individual earning capacity depends on individual productivity, higher wages have been a *direct result* of increased mechanical efficiency.

There is nothing new about any of these things. MACHINERY has repeatedly called attention to them through editorials and special articles. The point we particularly wish to emphasize here is that much good can be accomplished if executives tell their own men the industrial facts of life. This kind of education, like charity, should begin at home.

▼ ▼

The average age of the men on the factory payrolls of the B. F. Goodrich Co., Akron, Ohio, is forty-two years, and the average age of the women thirty-seven years. Over one-fifth of the company's male employes are fifty years of age or older, while only one-seventh are under thirty years of age.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism for Applying Rotary and Oscillating Motion to a Driven Shaft

By PAUL GRODZINSKI

The mechanism shown in the accompanying illustration is designed to give a rotary and oscillating motion to the driven shaft *E*. The oscillating motion is made possible by the reciprocating action of the segment gear *M*. When this motion is required, the driven shaft changes its direction of rotation every half-revolution and operates at one-eighth the full rotating speed of the motor driving shaft. When a continuous rotating motion is required for shaft *E*, sliding collar *D* of the clutch is engaged with clutch member *C*. Gear *F* then rides on the cylindrical part of the clutch member *D*, from which it is disengaged, and shaft *E* rotates continuously at the motor speed.

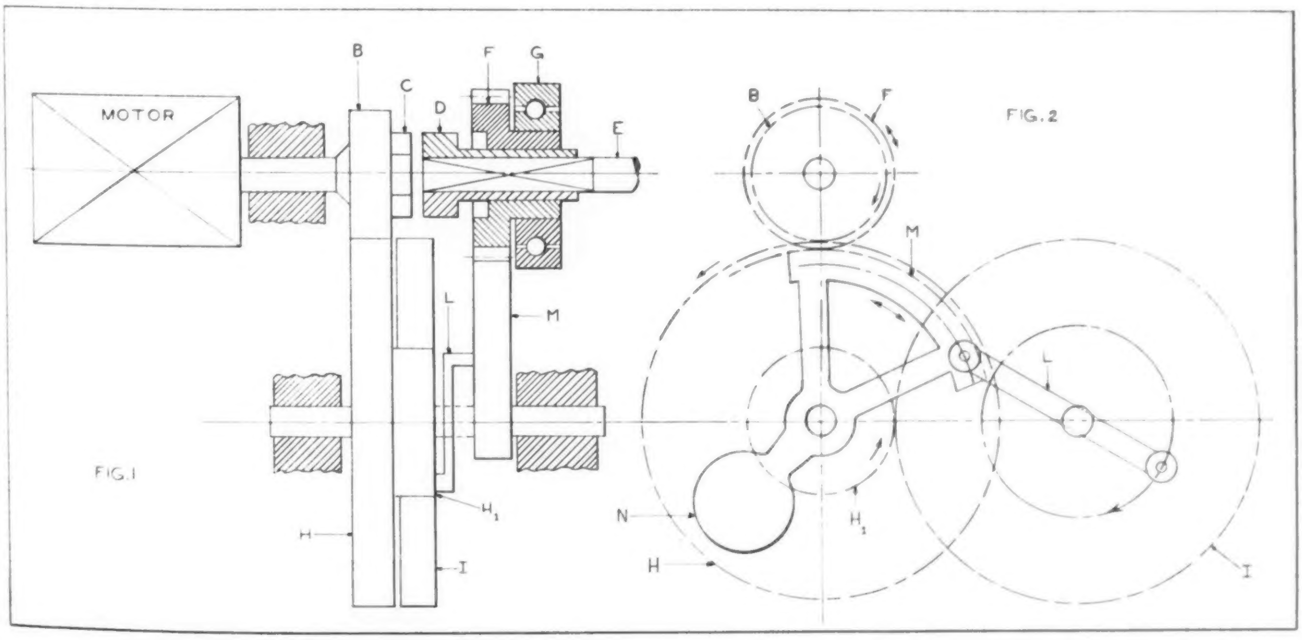
Fig. 1 shows the mechanism in the neutral position. The gears *B*, *H*, and H_1 have a ratio of 1 to 8. The diagram Fig. 2 shows the gearing arrangement that makes possible the oscillating motion. Crank *L* is attached to gear *I* in an offset position, so that it provides a crank movement for oscillating segment gear *M* which meshes with gear *F*. The ratio of the pitch diameters is so selected that gear *F* is rotated 180 degrees in a forward and return movement; gear *F* is connected to the driven shaft *E*, giving it a similar motion when member *D* is moved to the right. This mechanism can be improved by introducing a second clutch to permit gear *B* to be disconnected from the motor shaft for the direct drive and also by attaching a balance weight *N* on the segment gear *M*, as shown in Fig. 2.

Combined Reciprocating and Rotary Motion

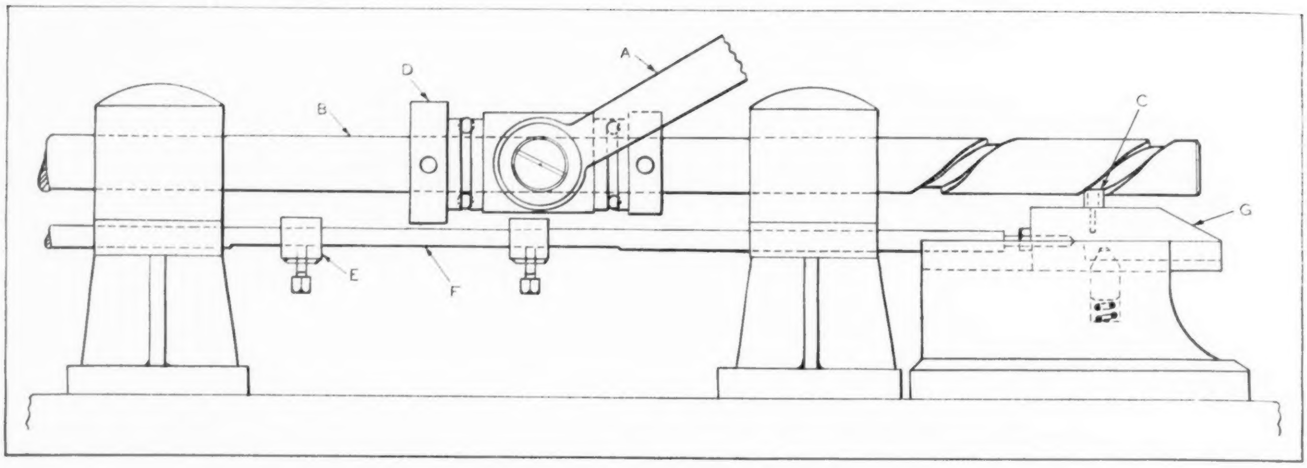
By W. M. HALLIDAY

A mechanism that was described in February MACHINERY on page 394 recalls to the writer a somewhat similar arrangement that was used on an experimental machine some time ago. (See illustration on the following page.)

Arm *A* receives a reciprocating motion from an independent source and transmits this motion to shaft *B*. When shaft *B* moves to the left, it is rotated through roller *C* engaging a helical groove in the shaft. This combined movement continues until the collar *D* comes in contact with stop *E*. Upon further movement of shaft *B* to the left, rod *F* and slide *G* are drawn to the left at the same speed. It can be readily seen that when this simultaneous



Oscillating and Rotary Mechanism for Applying Two Motions to the Driven Shaft E



Combined Reciprocating and Rotary Motion

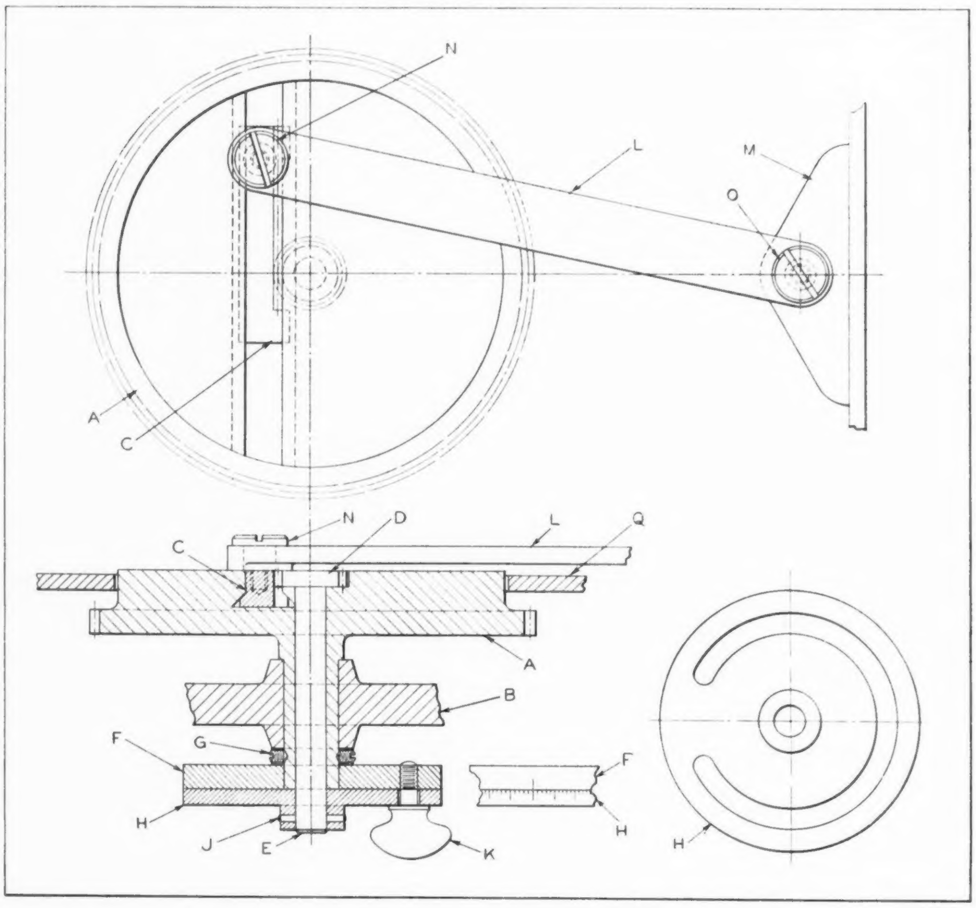
action is taking place, shaft B has no rotary motion. The position of stop E can be adjusted to vary the rotary motion of shaft B.

Variable-Stroke Mechanism

By JOSEPH WAITKUS

The accompanying illustration shows an interesting design for a variable-stroke mechanism that was recently devised in the development of a feeding arrangement. The device consists of a crankpin wheel A which is provided with an integral shaft supported in a bearing in the plate B. A slot is accurately milled in the face of wheel A to accommodate the movable eccentric crankpin block C.

Block C is provided with rack teeth which mesh with pinion D. The pinion is an integral part of the shaft E which extends through a bore in the shaft of wheel A. A locking disk F is fastened to the shaft of wheel A by two set-screws G. The adjusting disk H is fastened to shaft E by pin J. Disks F and H are locked together by screw K.



Mechanism for Varying the Stroke of a Reciprocating Motion

The eccentric movement is transmitted through link L to the pusher M. Studs N and O serve to connect the ends of link L to their respective members. The wheel A is arranged in position below a table top Q.

The operation is quite simple. Power is transmitted through a system of gears, not shown, to the gear that is an integral part of wheel A. The eccentric location of stud N produces the required reciprocating motion in the pusher M through link L. To adjust the eccentricity, thumbscrew K is loosened and disk H is turned slightly in the direction required to produce the necessary eccentricity. The adjustment is transmitted through pinion D to the gear rack on the eccentric block C.

The pinion and rack are so constructed that they mesh with practic-

ally no free motion. Disks *F* and *H* are of a large diameter and are provided with graduations. The adjustment of the disks relative to each other results in a correspondingly small movement of pinion *D* and block *C*. This feature, coupled with the elimination of free motion in the linkage and gear teeth, produces a very accurate adjustment of pusher *M*.

Mechanism for Operating Two Slides Alternately from One Shaft

By L. KASPER

The accompanying illustration shows the construction of a mechanism used on a packaging machine. Two slides *B* and *S* are operated alternately from the rotating shaft *D*, one of the requirements being that one slide start its movement when the other stops. Figs. 1 and 3 show the end and plan views.

The stationary part *A* of this mechanism is dovetailed to hold the two slides *B* and *S* on opposite sides, as shown in Fig. 1. Bearing *C* supports shaft *D*, which rotates in the direction indicated by the arrow. Lever *E* is free to turn on shaft *D*, and carries at its upper end the gear *K* which runs free on its stud. Gear *K* receives its motion from gear *L* which is keyed to shaft *D*. Connecting-rod *F* is carried on the stud on the upper end of lever *E* and the stud on slide *B*. Connecting-rod *J* is carried on a stud on gear *K* and a stud on slide *S*. Slides *B* and *S* are slotted, pin *G* passing through part *A* and acting as a stop for both of these slides. Spring *H* serves to draw lever *E* to the right.

Taking Fig. 3 as a starting point in the cycle, slides *B* and *S* are held against pin *G* by spring *H* acting on lever *E*. The rotation of gear *L* in the direction indicated by the arrow causes gear *K* to rotate in the opposite direction; this, in turn, causes rod *J* to draw slide *S* to the left, slide *B* remaining stationary until slide *S* is again returned to its resting point against pin *G*. In Fig. 3, the dotted outline of lever *J* indicates its position after slide *S* has completed its movement. As slide *S* is restrained from further movement to the right, continued rotation of gear *K* brings rod *J* to the center position, as in Fig. 2, thus causing lever *E* to swing to the left against the resistance of spring *H*. The movement of lever *E* draws slide *B* to the left, returning it to its resting point against pin *G* as rod *J* passes the center position, thus completing the cycle.

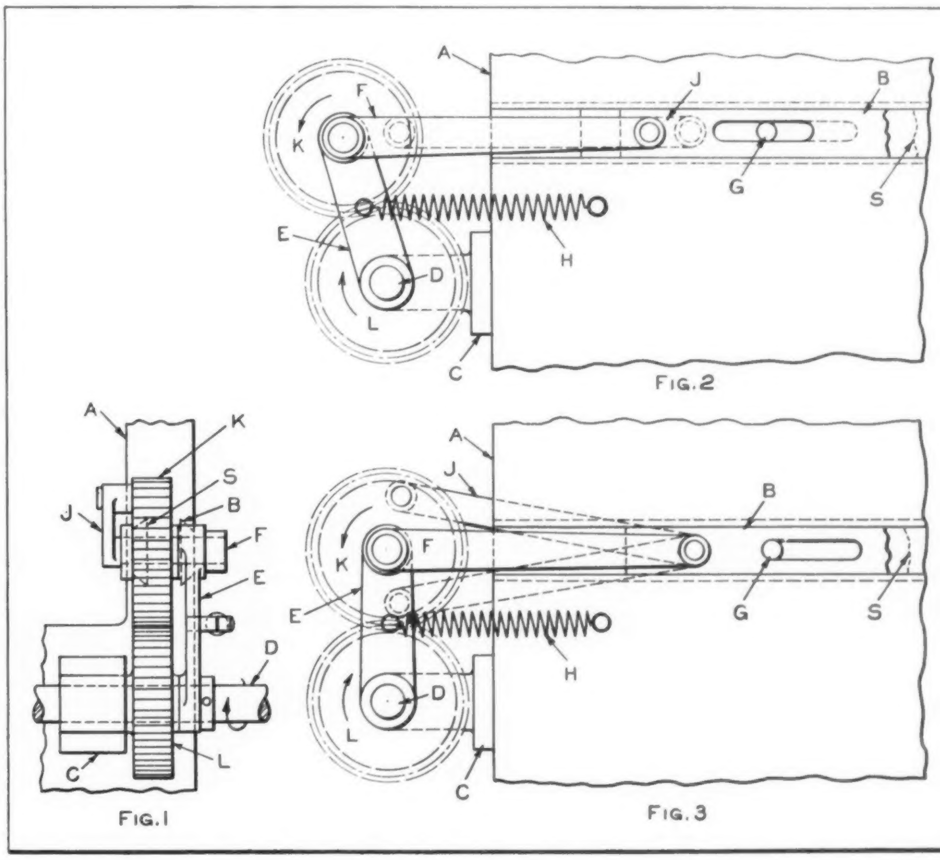


Fig. 1. End View of Mechanism, Showing Dovetail Slides B and S on Opposite Sides of Part A. Fig. 2. Plan View, with Slide B in Central Position and Slide S in Right-hand Position. Fig. 3. Slides B and S in Extreme Right-hand Positions

* * *

Mechanism Developed by Muller & Montag

On pages 562 and 563 of April MACHINERY, a milling machine spindle brake and circuit-breaker mechanism was described. In connection with the description of the mechanism, it should have been mentioned that the design was originated by the firm of Müller & Montag Maschinenfabrik, Leipzig, Germany, and that the illustration shown was obtained from one of the pamphlets published by this company, to whom credit, therefore, should have been given.

* * *

Forty-four of the ninety-three chemical elements known to scientists enter directly or indirectly into the production of automobiles.

Materials for Worm-Gear Drives

A Practical Study of Worm-Gear Drives, Presented Before the American Gear Manufacturers Association at the Annual Meeting at Virginia Beach, Va., May 15 to 17, 1939

By CHRISTOPHER H. BIERBAUM
Vice-President and Consulting Engineer
Lumen Bearing Co., Buffalo, N. Y.

WORM-GEAR problems are essentially bearing problems, met with under rather aggravated conditions, owing to the fact that, theoretically, only point or line contact can exist between the gear and its worm, and this contact is essentially a sliding contact. In the study of worm-gear problems, therefore, the basic principles of sliding surface bearing requirements should be given first consideration.

A recent study of the present condition of some of the bearings of early electrical machinery, which have been in continuous and successful operation for nearly fifty years, shows a wear so slight that it bids fair to predict a life of one, or more likely two, centuries. Both lead and tin base babbitts were represented. The conditions under which these bearings have operated must therefore be ideal and may well serve as a basis for guidance in our studies.

The conditions are specifically these: The bearing metals are made up of hard and soft crystals. The journals are of low-carbon, cold-rolled steel—a steel of a high degree of homogeneity; thus one member is possessed of a high degree of microscopic homogeneity, and the other possesses the heterogeneity of a bearing metal. The microhardness [see "The Microcharacter," Transactions A.S.S.T., January, 1931] of the bearings and of the journals is such that the bearings and journals mutually polish each other. Microscopically, we find the condition characteristic of a "run in" bearing surface; that is, the harder crystals in the bearings are in relief and the matrix or softer crystals are slightly depressed [see "A Study of Bearing Metals," Transactions A.I.M.E., 1923, page 972]. The lubrication consisted of oil-rings dipping into the sumps beneath the journals, and was therefore continuous and uninterrupted. The oil after six months of service showed no appreciable oxidation.

In modern worm-gear application, the usual or standard construction is a copper-tin bronze worm-wheel and a steel worm. The worm-wheel is prop-

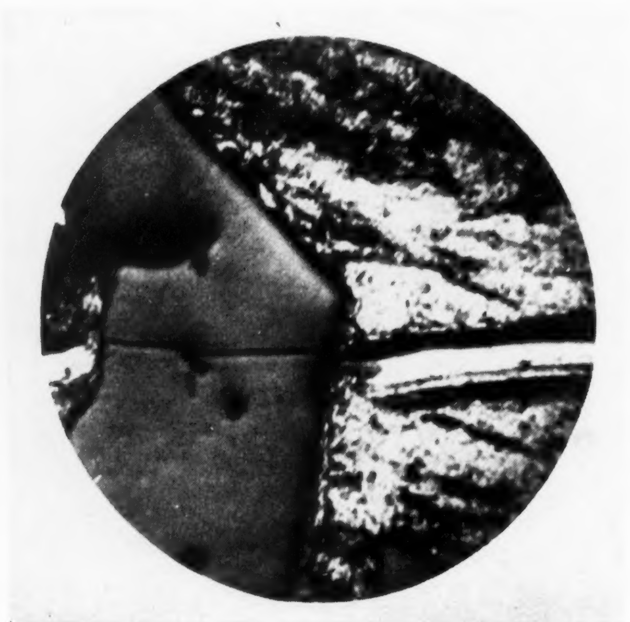


Fig. 1. Photomicrograph of a Fused Tin Oxide Crystal Embedded in Copper-tin Bronze with a Continuous Microcut. Magnification, 1000

Fig. 2. Photomicrograph of a Modified Bearing Crystal in Copper-tin Bronze, due to the Presence of Nickel. Magnification, 500

erly the wearing or bearing member. Years of experience clearly show that for best results the bronze should be cast under chilling conditions, the object being to produce a material that is relatively fine-grained and yet has a liberal supply of hard bearing crystals. The bronze should be a phosphor-bronze in reality, and not in name only; it should be free from all tin oxide.

Fig. 1 shows a metallographic surface of bronze with a fused tin oxide crystal embedded [see "A Study of Bearing Metals," Transactions A.I.M.E., 1923, page 972]; both the bronze and this crystal have a continuous microcut on them. The extreme fineness of the cut upon the crystal, compared with that on the bronze, gives an indication of the extreme hardness and destructiveness of this crystal.

In like manner, the bronze should be entirely free from all impurities that tend to produce hard and abrasive constituents. It is not sufficient to have a bronze of a definite chemical composition; it is all important that it should have the proper crystal structure—a relatively fine grain and a liberal amount of hard bearing crystals. The same bronze, with all of its tin in solid solution, and consequently no bearing crystals, has markedly higher physical properties, but lacks the necessary microstructure for a bearing metal [see Journal Institute of Metals, 1913, Vol. 9, page 178]. The foundry practice, therefore, should always be under strict metallurgical supervision.

In more recent years, as the result of the writer's microcharacter researches, it has been found that the introduction of a small percentage of nickel into the copper-tin bearing bronzes has its uses. [U. S. Patent No. 1,687,924, issued Oct. 16, 1928] It is possible thereby to increase the compressive strength of the bronze by as much as 5000 pounds per square inch. It modifies the structure of the bearing crystal by making it a solid mass formation, as shown in Fig. 2, instead of the usual eutectoid structure, as shown in Fig. 3. The presence of nickel makes this crystal more abrasion-resistant without increasing the hardness of the soft alpha crystal. The range of microhardness between the hardest and softest crystal in the bronze is not, therefore, decreased by the addition of nickel; its presence also increases to a degree the corrosion resistance. However, the presence of nickel tends to increase slightly the hardness of this modified bearing crystal.

A bronze worm-gear made under proper metallurgical supervision, therefore, meets the ideal conditions of a bearing metal—that of being made up of hard and soft crystals. Bronze gears with varying percentages of lead have been found suitable to run with worms made from different soft steels, not hardened. In some extreme cases where the worm-gear is subjected to excessive stresses and severe shocks, and where the physical strength is of more importance than the properties of a bearing metal, aluminum bronze with varied heat-treatments has given excellent results when used with a standard steel, not casehardened, but simply heat-treated. In the use and application of worm-gears, the metallurgy of the bronze wheel seems, in general, to be simpler and better understood than that of the steel worm.

The Usual Type of Worm Employed in Worm-Gear Drives

The difficulty in meeting one of the stated ideals, namely, that of having the two members of a bearing mutually polish each other, lies in the fact that the steel worm is so much harder than the bronze wheel. This applies especially to the modern case-

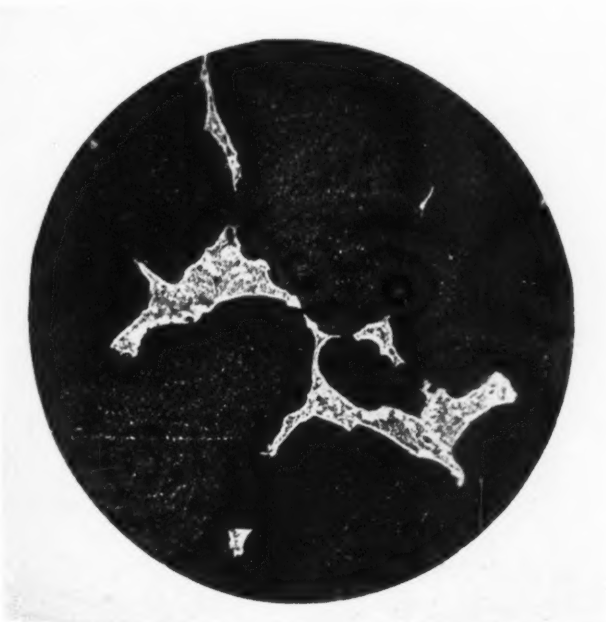


Fig. 3. Photomicrograph of the Eutectoid Crystal Usually Found in Copper-tin Bronze. Magnification, 500

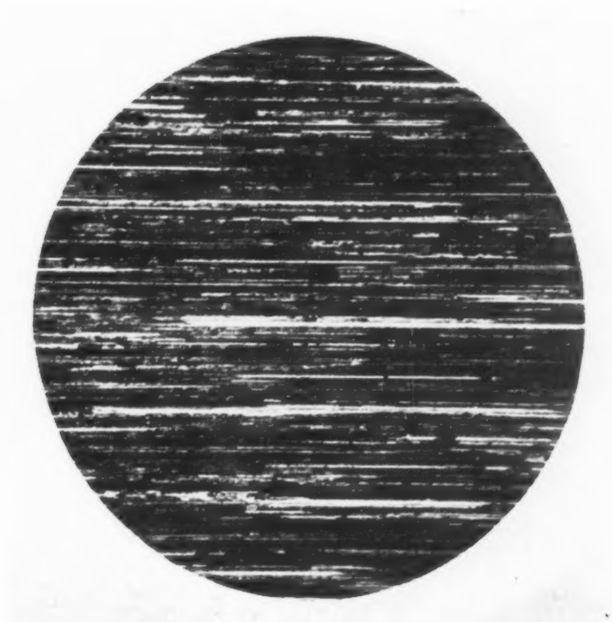
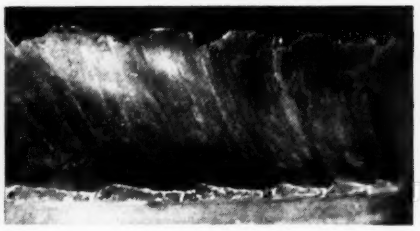


Fig. 4. Photomicrograph of the Surface of a Case Ground with an Alundum Wheel, 60 M. Magnification, 100



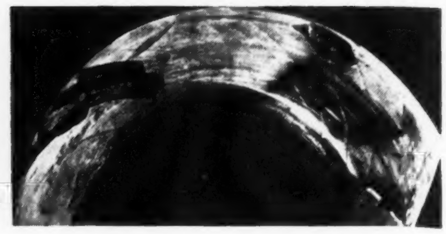


Fig. 5. (Left) Part of a Bronze Worm-gear Showing the Extreme Pitting Produced on the Gear Teeth by a File-hard Worm Surface. Fig. 6. (Center) Section of a Bronze Worm-gear Rim Showing the Milling Effect of Fine Checks in the Mating Worm Case. Fig. 7. (Right) Section of a Worm Showing how the Casehardened Case Crushes and Chips off, Producing a Very Rough Surface

hardened worm. Fig. 4 is a photomicrograph of the surface of a case ground with an Alundum wheel, 60 M. To the unaided eye, it appears to be a very creditable finish, and in fact, it is fully equal to the average ground worm surface used in general practice; still, the depth from the high ridges to the bottom of the grooves varies between ten and fifteen ten-thousandths inch.

The surface, of course, is file hard, and the sharp grooves cut in it are not in line with the direction of the rubbing surfaces. A supporting oil film cannot possibly prevent actual interaction between the surfaces. An effective file surface is presented, with the result that the first part of the "running in" process simply means the dulling of this file surface. Under these conditions, the amount of heat and extreme friction set up tend to produce intercrystalline and intergranular ruptures, which show their effect in the form of pitting upon the bronze gear teeth, as indicated in Fig. 5.

In other words, a bronze gear may be completely ruined before the worm is in the proper service condition; in fact, the case on the worm itself may even be ruined at the same time. In the modern worm-wheel construction, where such an extreme difference of hardness exists, the ideal condition of the two members mutually polishing each other does not obtain, and for good results, therefore, it is necessary that the worm be given a high finish before it is put into service. The harder the worm, the more important the finishing.

The Effect of Carburizing on the Worm

In the process of manufacture, the worms are subjected to the intense heat of carburizing, followed by chilling and finally by drawing; therefore, they are all subject to more or less warping and distortion. Then, if for the final grinding the original end centers are used, as is standard practice, it is evident that any distortion that may have occurred will cause a variation in the depth of the final case. In mass production, it has been a not infrequent occurrence to find worms that had spots in which the case was removed completely, leaving the worm in a condition that always must prove disastrous. All of this difficulty is overcome by using a worm that has no case and is of uniform hardness throughout.

In the carburizing of a steel worm, this carburized material expands in volume, thus putting the case material in compression and that immediately beneath it in tension. The thermal coefficient of expansion of the carburized material is distinctly increased, and under working conditions, the temperature of the case is always higher than that of the core [see "Surface Hardening for Bearing Purposes," MACHINERY, November, 1935]. All these conditions tend to produce a buckling and cracking of the case. This is especially true where a sharp line of demarkation exists between the case and core, since it is along this line that rupture occurs. Any chipping or mere checking of the case is exceedingly destructive to the bronze wheel, and in any application in which a case shows the slightest signs of disintegration, the worm should be summarily rejected.

Fig. 6 shows part of the circumference of a worm-wheel with the teeth completely milled off; yet the surface of the mating worm seemed not to have suffered. Close inspection, however, revealed the surface of the worm case to have innumerable fine checks, the edges of which had acted as effective milling cutters. Fig. 7 shows a case of insufficient depth; the material immediately beneath the case is too soft to support the load, since the cracks follow the successive contact lines between the surfaces. The practical shortcomings of case- or pack-hardening for the worm have not been given the scientific study they deserve.

Examples of Worm-Gear Drives Having Unusually Long Life

In the early adaptation of the modern truck worm drive, some almost phenomenal results were achieved; some of these worm-gears in heavy trucks have given uninterrupted and continuous service for a period of from eighteen to twenty-three years. An intensive study of a number of these early gears was most illuminating. The bronze wheels showed a chemical composition of substantially 89 per cent copper and 11 per cent tin, with a microscopic grain structure that indicated a proper chill effect. The worn surfaces of the worm-wheel teeth were free from all indications of pitting and presented a smooth mirror-like surface. Microscopical examination of the surfaces showed the true character-

istics of a "run in" bearing surface—that is, the hard bearing crystals were in relief by an amount of from 3 to 6 microns, and the matrix or softer crystals were depressed [see "A Study of Bearing Metals," Transactions A.I.M.E., 1923, page 972]. A study of the worms proved of even greater interest; they had been pack-hardened, and during this long service, the cases remained free from all checking and chipping off. Likewise, in their final condition, they presented a polished, mirror-like surface.

Metallurgical and microcharacter studies of the case showed that it did not possess the brittle hardness of the modern case; that it was of unusual depth; and that it blended gradually into the core without a distinct line of demarkation between the case and the core. Upon inquiry into the early practice, it was established that these worms had been pack-hardened by placing them in animal charcoal and then heated for a period of from twenty to twenty-two hours, oil-quenched, drawn, and polished.

Substitutes for Casehardening Steels for Worms

A number of representative manufacturers who in years past have experienced persistent trouble with their casehardened worms have now abandoned casehardening altogether, and have adopted some standard S A E steel with a suitable heat-treatment. In the heat-treatment of these steels, the necessary hardness can be obtained, with the highest possible degree of microscopic homogeneity; for this reason, this heat-treatment should be given the fullest consideration.

The steel should be clean and free from all abrasive inclusions. Zirconium is sometimes used as a deoxidizer and scavenger in the refining of steel, but any trace remaining in the steel is highly detrimental when it is used in bearings. Fig. 8 shows a small cuboid crystal of zirconium-nitride embedded in the surface of a hard case. In the illustration, a microcut is shown across the crystal. The width of the cut on the crystal, compared with the width of the cut on the hardened steel, gives a basis for calculating the relation of hardness of this crystal, compared with the hard case. This crystal has a hardness equal to that of sapphire or corundum; it is more injurious, however, since it is not so brittle.

The argument has been advanced that so small a crystal cannot possibly produce injurious results; true, one crystal cannot, but when thousands are present, destruction of the bearing surface is inevitable. The same criticism applies to other like abrasive impurities that may be present, among them the nitrides of titanium, tungsten, tantalum, and others. It is not only necessary to know that the steel for the worm possesses the physical properties demanded for the service; it is also highly important to know that the steel is clean and free from cinder and all abrasive inclusions.

Results of Studies of Worm Cases

Fig. 9 presents the results of microcharacter studies of actual cases that have come under the writer's observation. Curves *A*, *B*, *C*, and *D* represent nitrided nitralloy cases, and *E* and *F* pack-hardened cases. At first glance, it is evident that the nitrided nitralloy cases present an unusually high degree of homogeneity not inherent in the pack-hardened cases, which latter are made up of an aggregation of crystals of a varying degree of hardness. Nitrided nitralloy steel, for bearing purposes, has never been given the attention or consideration it deserves. Of necessity, its use is more expensive than the use of the efficient casehardening process, but for results it cannot be surpassed.

As an illustration, one of the helical gears on the engine of a Greyhound bus driving the oil-pump and one timing unit at full engine speed has a velocity of the sliding surfaces of 1 1/10 miles per minute. One member of this helical gear is nitrided nitralloy and the other a copper-tin bronze. In the first test, there was no special finishing of the nitrided surfaces; the nitrided surface, as taken from the furnace and as represented by curve *D*, was put directly in service, with the result that after running the engine on the block for a few hours, the bronze gear was badly worn—in fact, the teeth were nearly gone.

The first impression, therefore, was that nitrided nitralloy should be condemned for worm-gear service. An examination of this nitrided surface under magnification revealed the fact that in the nitrided condition in which it was put in service, a velvet-like surface was presented in which the bronze was embedded. It was, therefore, evident

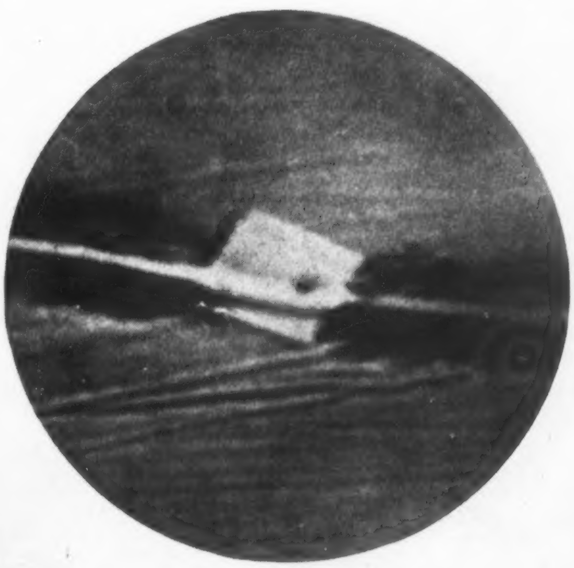


Fig. 8. Photomicrograph of a Zirconium-nitride Crystal Embedded in a Hardened Steel Surface with a Continuous Microcut upon the Crystal and the Steel. Magnification, 3000

that finishing or burnishing was absolutely necessary. This was accomplished by cutting a gear wheel of hard wood, uniform in size and form with the bronze member, and then running the nitrided gear against the wooden wheel, which had been impregnated with oil and fine emery dust, until a mirror-like surface was obtained. The same nitrided member was then put back into service, mating with a bronze gear made from the same heat of metal as the first, with the phenomenal result of having very little or no wear after the bus had run over 200,000 miles. This clearly shows that a polished, highly homogeneous surface is more essential than extreme hardness.

The inadequacy of testing casehardness by the ordinary methods of hardness testing is clearly shown in the results obtained in testing the cases of two extremely hard nitrided nitralloy steels, as indicated by curves *A* and *B;* these two steels have the following respective compositions:

	A	B
Carbon	0.60	0.315
Manganese	0.58	0.63
Phosphorus	0.01	0.018
Silicon	0.20	0.16
Chromium	1.03	1.12
Molybdenum	0.20	0.19
Aluminum	1.04	0.93

It will be observed that the extreme microhardness of both steels *A* and *B* is the same, yet when these surfaces are tested by Vickers-Brinell under 10 kilograms, there is a distinct difference in results. The hardness of *A* is shown to be 800, whereas *B* is 925. This is due entirely to the soft outside layers on these surfaces; that on *A* being deeper than that on *B* is responsible for this difference in results, with a 10-kilogram load. If, however, a heavy load is used in the Vickers test, say 100 kilograms, the hardness results will be reversed. *A* will then be the harder, and *B* the softer.

The same inaccuracy of casehardening testing is found, in a measure, in all present commercial methods of case testing. The true nature of the different cases has not been shown except in the microcharacter researches. Another cause of misapprehension in case testing is found in the fact that if a metallographical surface is etched with, say, nitol, it will show a decoloration far deeper than the actual case; but this decoloration is generally considered as representing the true depth of case. To illustrate: Curve *E* is supposed to show an exceptional product of casehardening. It represents S A E 4615 steel, carburized for four hours at 1650 degrees F., oil-quenched from the pot, reheated to 1450 degrees F., oil-quenched, and tempered at 300 degrees F. Curve *F* represents an ordinary case of S A E 6115 steel, carburized for four hours at 1650 degrees F., water-quenched from pot, reheated to 1450 degrees F., water-quenched, and tempered at 300 degrees F. Now the hard part of cases *E* and *F* does not extend beyond 0.15 millimeter, whereas the decoloration in an etch extends to 0.70 or 0.80 millimeter. The foregoing fact is often a source of general misapprehension by the heat-treater in practice.

Recently Introduced Hardening Methods

A more recent method of hardening steel bearing surfaces that seems to be of considerable promise is the sudden heating and chilling process. The heating is accomplished in two ways—by torch or by electric induction. In either case, the steel surface to be hardened is heated almost instantaneously, followed by an equally instantaneous chilling.

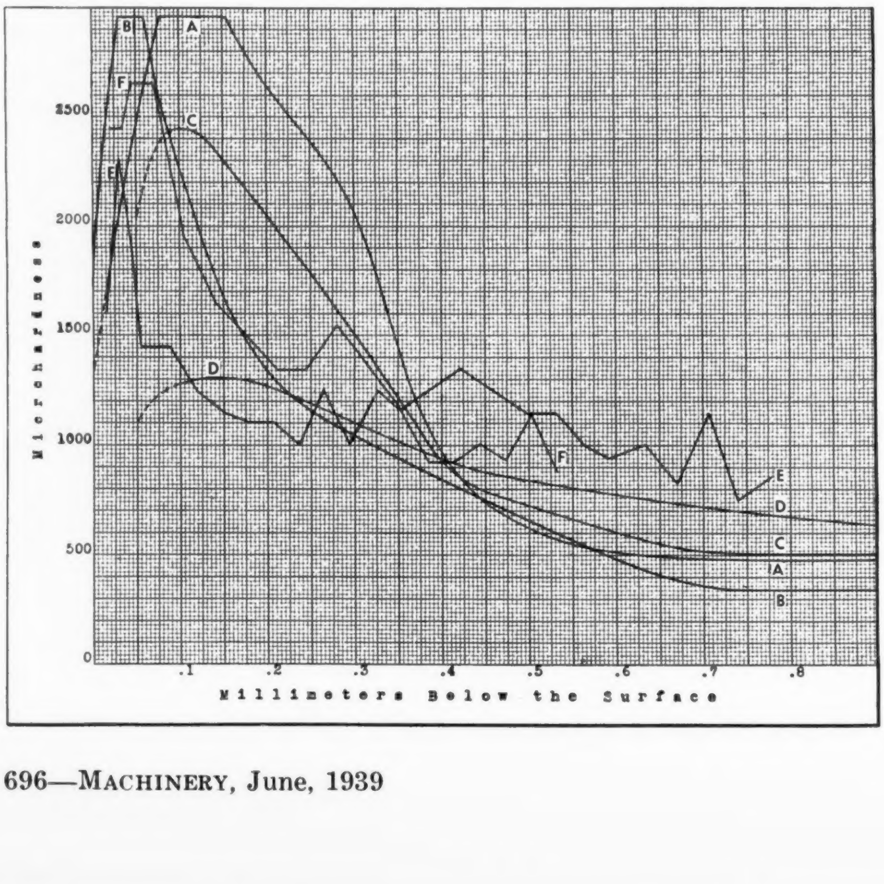


Fig. 9. Curves Showing Microhardness Studies of Nitrided Nitralloy and Pack-hardened Steel Cases

The two effects are so sudden that any grain growth during the short interval is practically impossible. This method has in its favor the possibility of producing a surface of sufficient hardness and depth, with the virtue of a gradual blending of the hardness of the surface into that of the core, when applied to a properly selected steel.

Modern efficiency casehardening has proved a tremendous disadvantage in the application of worm-gear service. This conclusion is not based upon isolated instances. It is the result of years of observation and the study of thousands of worn out bronze worm-gear rims in which every rim showed the destructive effect of the broken case of its mating worm. These facts, on the one hand, and the very successful results with plain heat-treated standard steels on the other, seem to justify the unconditioned condemnation of modern efficiency casepack and cyanide hardening for all bearing purposes, when the casehardened part is to run with bearing metals.

The matter of lubrication also deserves consideration, especially in regard to the oxidizing of the oil. As the oil oxidizes it becomes acidified, and consequently corrosive in its effect on bearing metal surfaces [see "Corrosion Effects of Lubricants upon Bearing Surfaces," *Iron Age*, August 31, 1933]. In extreme cases, the life of the wormwheel or of a bearing may be shortened materially, or even be completely destroyed, by extreme oxidation of the oil [see "Corrosion of Bearing Surfaces," *Mechanical Engineering*, April, 1935]; therefore, to meet the ideal conditions, the oxidation of the oil should be extremely slight or absent altogether. A like precaution against corrosive effects should apply to the various constituents added to the lubricating oils for the purpose of producing the extreme pressure (E.P.) effects.

* * *

Machinery Exports in March Reach High Level

Industrial machinery exports from the United States during the month of March, the last month for which complete statistics are available, were valued at $29,594,000, an increase of 17 per cent over the exports in March, 1938, according to the Machinery Division of the Department of Commerce, Washington, D. C.

Exports of power-driven metal-working machinery reached the record volume of $12,057,000 in March, this year, an increase of 45 per cent over the corresponding shipments in 1938, when the exports were valued at $8,297,000. Continued large shipments of machine tools to Russia, Japan, and the United Kingdom, added to sharply increased shipments to France, were primarily responsible for the high level reached during March. Over 80 per cent of the exports in power-driven metal-working machinery went to the four countries mentioned.

Financial Reports that Can be Read at a Glance

Many industrial concerns today are publishing financial reports and balance sheets made up in a manner that can be understood at a glance not only by those familiar with accounting practice, but by the average employe and stockholder. Revere Copper and Brass, Inc., has done a great deal along these lines.

Recently the company published a booklet entitled "How Revere Got Its Money and How Revere Spent Its Money in 1938." This booklet is addressed to the company's employes. It starts out by telling how much the concern took in from sales and other sources during the year, and then goes on by saying: "The company used this money to pay the following bills and expenses in 1938: (1) Bills for metals; (2) bills for fuel, supplies, freight, etc.; (3) bills for wear and tear, replacement of buildings, machinery, and equipment; (4) bills for interest on money borrowed to conduct the company's business; (5) bills for taxes to Uncle Sam, state, and city governments; (6) allowances to customers who paid their bills promptly and thus obtained a cash discount; (7) sums set aside for bad debts, because some customers did not pay their bills; and (8) cost of damage caused by the hurricane to the New Bedford, Mass., plant last fall." Against each one of these items the total amount paid out by the company is given in dollars and cents.

The statement ends by pointing out that, after all the bills had been paid, there was less left in the till than was required for wages and salaries, but since wages and salaries had to be paid, it meant that the company had a loss for the year amounting, in this case, to over $2,000,000. That meant, of course, that the stockholders during 1938 received *nothing*.

The booklet also points out that in spite of the losses met, which were equivalent to about $400 for every man and woman employed, the company continued to employ an average of 5600 men and women. It also mentions that the company has invested over $3000 for every person working for the firm, in buildings, machinery, and equipment necessary for the employment of the workers.

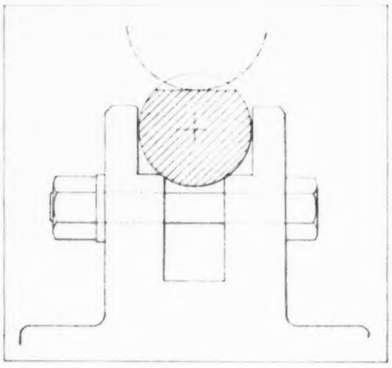
* * *

Meeting of Rockford Chapter of Tool Engineers

The Rockford Chapter of the American Society of Tool Engineers met at the Hotel Faust, Rockford, Ill., Thursday, May 11. At this meeting Ralph A. Powers, vice-president of the Electronic Control Corporation, presented a paper, accompanied by working displays, on the subject "Photo-electric and Various Electronic Devices as Used in Industry." A demonstration and discussion of "Superfinish" was furnished by engineers of the Chrysler Corporation.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Vise or Clamp for Holding Shaft on Milling Machine Table

Shaft Clamp for Milling

A simple vise or clamp for holding shafts while they are being splined or milled is shown in the accompanying illustration. By simply tightening the nut on the bolt, the work is securely clamped. Smaller shafts can be accommodated when necessary by inserting packing shims. F. H.

Sealing Ends of Bearings when Babbitting

For luting or sealing the ends of bearings when babbitting, the writer has been using a mixture of heavy cylinder oil and flour asbestos for many years. This mixture can be used time and again, and is much more convenient to handle than either putty or clay.

Elizabeth, N. J. WILLIAM P. FLYNN

Yearly Drive to Use up Waste Stock

In the course of a year, there is, in almost every shop, a considerable amount of waste stock, which, for some reason or other does not meet the specifications of the part to be fabricated. In addition, there are many odds and ends cut from longer pieces, for which there is no immediate use.

If a bin were provided where these odds and ends of stock could be accumulated, it would be an excellent idea to let somebody sort these pieces, say, once a year. A certain week could be designated as "odds and ends week," during which an intensive effort would be made to use up these waste pieces of stock.

It might require a little longer to find the piece of stock meeting the proper specifications, but it is surprising how many parts can be used up, if an effort is made during a definite period to utilize these odds and ends. This idea was tried in a well-known plant, and worked well.

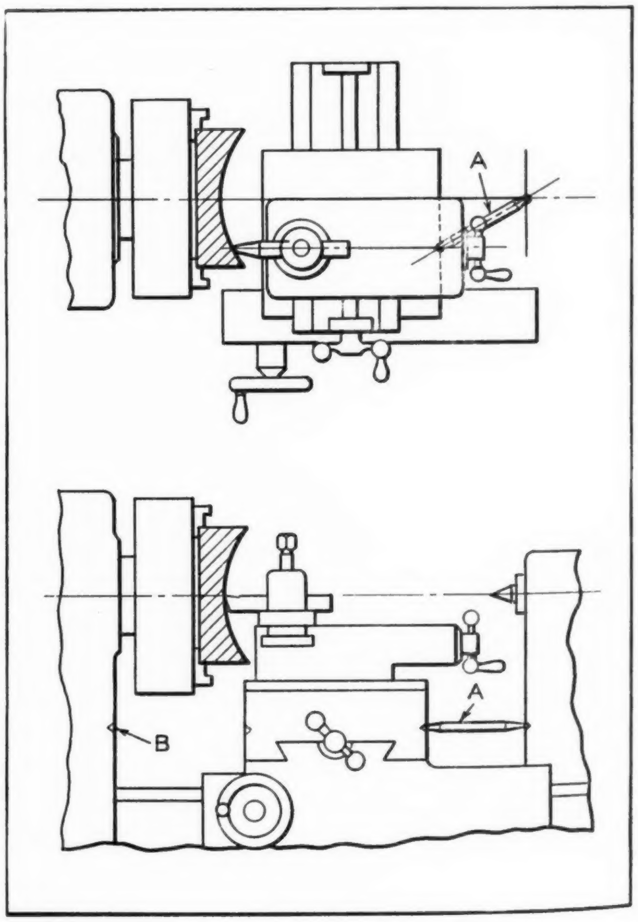
Hudson, N. H. ROGER C. DICKEY

Simple Concave and Convex Turning Arrangement

A radius pin such as shown at *A* in the accompanying illustration, which is the same length as the radius to be cut, can be used in both concave and convex turning operations on a lathe. The radius pin is placed against the headstock at *B* for convex turning, and against the tailstock, as shown at *A*, for concave turning.

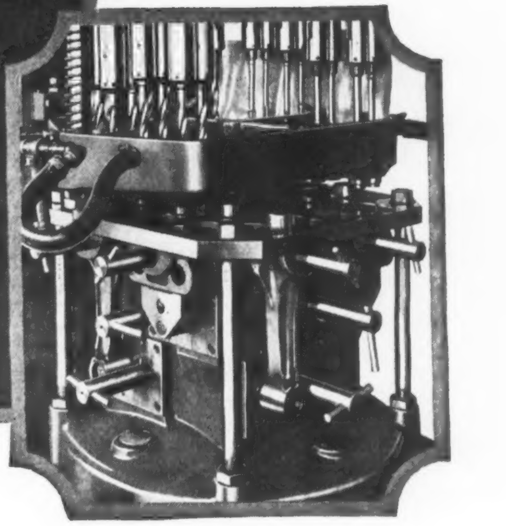
In turning work to a radius with this arrangement, the cut is started with the tool on center and the radius pin parallel with the axis of the lathe spindle. With the radius pin located in this manner and the spindle rotating, the cross-feed is thrown in and the handwheel employed to obtain the longitudinal movement of the carriage required to hold the carriage against the radius pin.

Green Bay, Wis. C. J. TOONEN



Radius Turning Arrangement Consisting of Radius Pin A and Supporting Centers for Pin A in the Tailstock, Headstock, and Carriage

Design of Tools and Fixtures



Die for Making Six Right-Angle Bends

By L. KASPER, Philadelphia, Pa.

A completely formed piece like the one shown at *A*, Fig. 1, is produced from flat stock at each stroke of the press, using the die shown in Figs. 1 and 2. Piece *A* has six right-angle bends which are made in two operations on the die, two different pieces being subjected to bending operations at each stroke when the press is in operation. As the cutting and piercing sections of the die are of conventional design, they are omitted in the illustration, for simplification.

In Fig. 1 the die is shown with the ram of the press in the uppermost position. *B* represents the forming die which carries slide *C*, the slide being operated by cam *D* attached to the back of the punch-holder *E*. Punch-holder *E* carries punch *F* and pressure pads *G* which form the initial bends in the work. Punch *H*, attached to the front of holder *E*, performs the final bending operation. Slide *I*, mounted on the lower end of punch *H*, serves to strip the work from the projecting end of punch *H*. Roller *J* is employed to operate slide *I* when the press ram reaches the end of its downward stroke.

The view to the left in Fig. 1 shows slide *C* in its extreme forward position under the incoming strip *A*. The purpose of slide *C* is to push blank *A* to position A_1 after the initial bends have been made, so that it will be in position for the final bending operation, as shown in section *Y–Y*, there being two blanks in the die at all times. As the ram descends, slide *C*, section *X–X*, is drawn to the rear of the die by cam *D*. Pilot *K* in punch *F* enters the hole in the blank, thus preventing the blank from slipping. Punch *F* then pushes the blank into die *B*.

As the ram ascends, the action of cam *D* causes

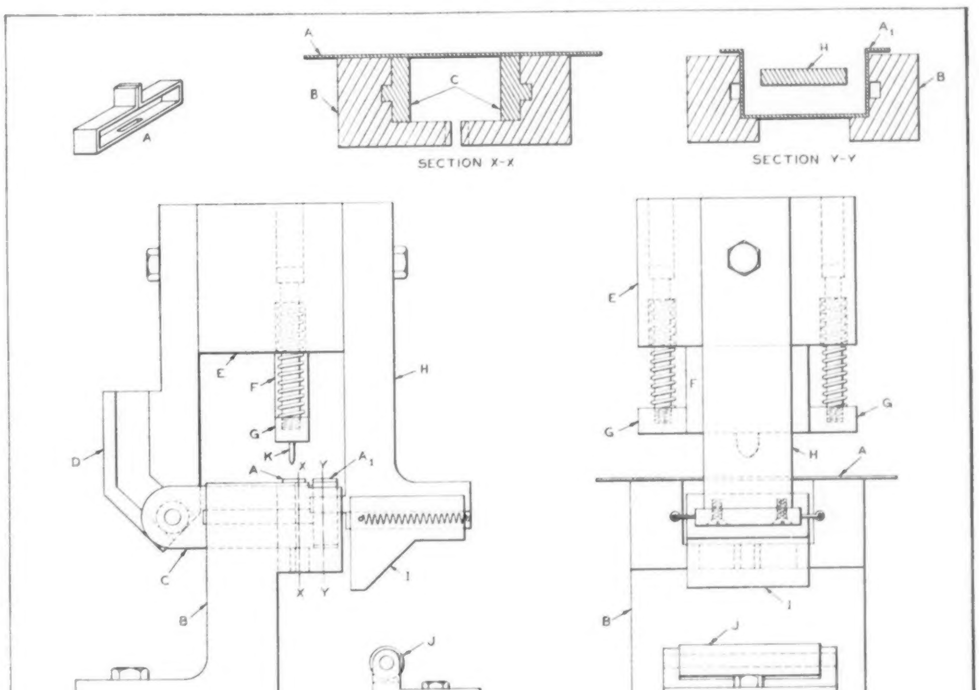


Fig. 1. Die Designed to Produce Completely Formed Part Like One Shown at A at Each Stroke of Press

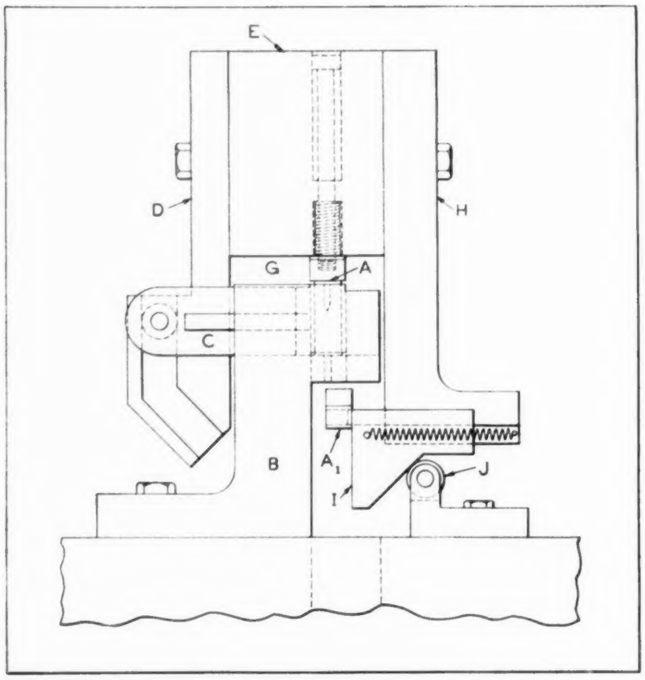


Fig. 2. Die Shown in Fig. 1 as it Appears in Closed Position about to Eject Finished Piece at A_1

slide C to move forward, pushing the partly formed blank into position A_1. Section Y–Y of die B, Fig. 1, shows blank A_1 in position for the final forming operation. When the blank is in this position, the projecting end of punch H extends between the two sides of the partly formed blank. As the ram descends, the end of punch H pushes the blank through the opening in the end of die B, producing two right-angle bends and causing the two sides of the blank to fold around punch H.

Referring to Fig. 2, which shows punch H near the bottom of the stroke, the initial bend is almost completed in the flat blank A, while the finished piece A_1 has been carried through die B by the end of punch H. Near the bottom of the stroke, slide I comes in contact with roll J, which causes the slide to move toward the rear of the die. In this manner, slide I strips work A from punch H. Fig. 2 shows the finished piece about to be stripped from the projecting end of punch H. On the completion of the downward stroke, the finished piece drops off the end of punch H and through the hole in the bolster plate. To avoid confusion, the partly formed piece is not shown in the view of the die at the right in Fig. 1.

Portable Tool for Cutting Graduation Lines

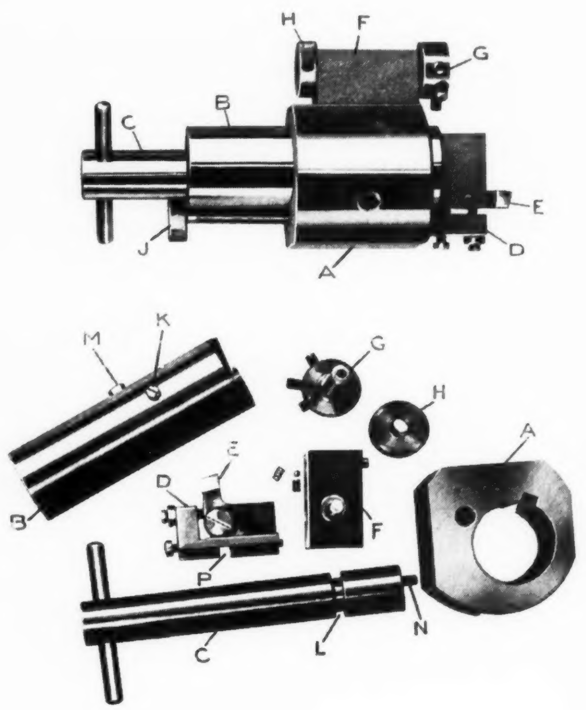
By O. S. MARSHALL, Pasadena, Calif.

The portable tool shown in the upper view of the accompanying illustration is designed for cutting graduation lines of three different lengths, such as are required for micrometer dials, dividing heads, scales, etc. It is arranged for convenient attachment to any type of machine on which the work to be graduated may be mounted. The main block A which supports the unit is provided with two flat surfaces machined to an included angle of 90 degrees. These surfaces are parallel with the bore of the block, as shown in the lower view of the disassembled parts. All the pieces comprising the tool, with the exception of the screw J, are shown in the lower view. Screw J has a knurled head and is used to control the depth of line cut by tool E.

The assembled tool is shown in the working position for imparting vertical strokes to the cutter E. When the tool is in use, the cross-pin at the left end of bar C is rotated to cause tool E to move vertically until stopped by one of the three adjustable stop-screws on disk G. Disk G can be located to bring any one of the three stops into position for cutting either a long, short, or medium length graduation. Rotation of bar C in the opposite direction returns the cutter to the stationary position, ready for the next cut.

Bar C is fitted into an eccentric hole in sleeve B, and is kept in position by the end of pilot screw K which extends into the groove L. The key M in sleeve B fits into the keyway in block A. The dovetail machined on the base of the cutter-slide D is a sliding fit in the dovetail groove in the end of sleeve B. Slide D is actuated by the eccentric pivot or pin N of bar C. Pin N engages the slot P in slide D and thus imparts the required vertical movement to the slide when bar C is rotated.

The knurled head or collar H, fitted to the spindle of the part G, facilitates turning the latter member



Views of Assembled and Disassembled Tool for Cutting or Scribing Graduations

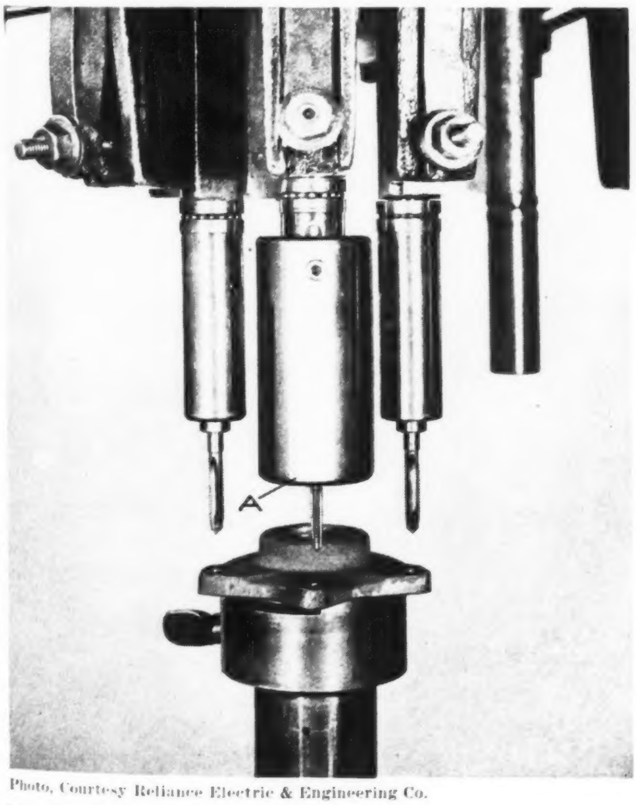
to bring the required stop into position for the length of graduation to be cut. The small ball, screw, and spring shown at the left side of block F fit into a recess in the latter member. The ball is backed up by the spring and drops into a recess at each stop position of disk G, thus acting as a spring tension lock or detent. The cutter-slide assembly D includes a hardened steel screw and tempered steel cup-washer for holding the cutter to its block; a thrust screw which backs up the cutter; and a small stiff coil spring which keeps the cutter against the thrust screw, but permits it to pivot on the reverse stroke. In the tool illustrated sleeve B is 1 3/4 inches in diameter, and bar C 7/8 inch in diameter.

Multiple Tapping of Different-Sized Holes in One Operation

By JOSEPH I. KARASH, Tool Design Department
Reliance Electric & Engineering Co., Cleveland, Ohio

In multiple tapping, it is sometimes desirable to tap more than one size of hole in the same operation. When a multiple drilling head is used for this work, all the taps are driven at the same speed. Since small taps have more threads per inch than larger ones, the larger taps, with their coarse threads, will enter the work faster than the small ones, with the finer threads. This necessitates some sort of floating tap-driver to compensate for the difference in tap leads.

The operation can be accomplished with floating tap-drivers, but most drivers of this kind carry the taps a considerable distance from the point of support. In order to keep all the taps in the same plane, extensions have to be provided for the remainder of the taps.



Photo, Courtesy Reliance Electric & Engineering Co.

Fig. 1. Floating Sleeve A Used in the Multiple Tapping of Different-sized Holes

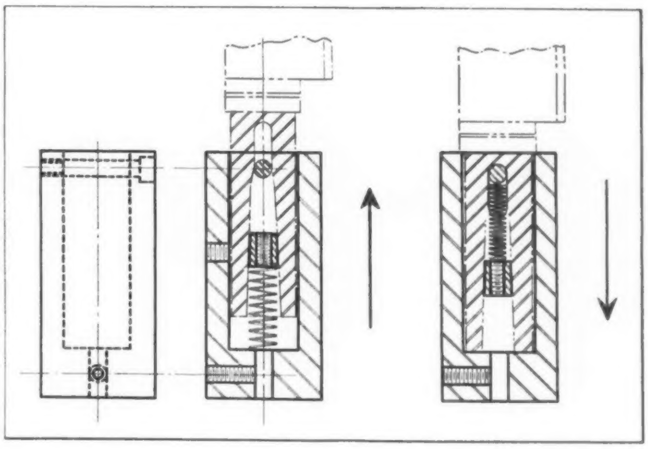


Fig. 2. Floating Sleeve for Tap, which can be Arranged to Float either up or down, as Indicated by the Arrows

A very simple tap-driving sleeve was designed to overcome the objections to the ordinary floating driver. This sleeve is shown at A, Fig. 1, and in the three views in Fig. 2. The floating sleeve is machined to a slip fit over the spindle of the standard drilling machine, thus taking advantage of the hardened and ground surface of the spindle. The tang slot in the spindle determines the limit of the floating movement of the sleeve. A socket-head cap-screw through the tang slot serves as a driving pin. The tapered hole in the drill spindle is used to hold the necessary spring. A small plug is inserted in the tapered hole to provide backing for the spring. There is a tapped hole through the plug to facilitate its removal.

The floating tap-driving sleeve extends the tap only slightly below the drill spindle, the amount it extends being easily compensated for by the vertical adjustment on the individual drill spindle. The tap-driving sleeve is intended to be an auxiliary piece of equipment, it being slipped over the drill spindle after the drilling operation is completed.

This sleeve is particularly useful in that the remainder of the taps can be inserted directly into the drill spindles. For small work, this floating sleeve can be used advantageously with a floating work-holder. The float of the sleeve can easily be reversed, if desired, by placing the spring above the plug, as shown in the view to the right in Fig. 2. The purpose of the reverse float, as indicated by the arrow, can best be understood by studying the three fundamental conditions that may occur in multiple tapping:

Case 1—Four holes are to be tapped at the same time. Three of the holes are to have 1/4-inch threads, and the other is to have a 10-24 thread. Only one floating sleeve would be required for the operation. The three 1/4-inch taps would be held directly in the drill spindles. The floating sleeve driving the 10-24 tap should have the spring below

the plug, as shown in the central view, Fig. 2, to allow the tap to float upward, as indicated by the arrow.

Case 2—Four holes are to be tapped at the same time. Three of the holes are 10-24, and the other is 1/4 inch. Only one floating sleeve would be required. The three 10-24 taps would be held directly in the drill spindles. The floating sleeve driving the 1/4-inch tap should have the spring above the plug to allow the tap to float downward.

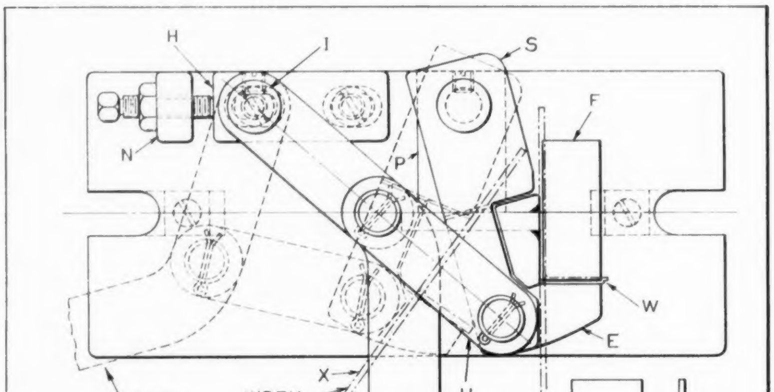
Case 3—Three holes of different sizes are to be tapped at the same time. The sizes are 10-24, 1/4 inch, and 5/16 inch. Two floating sleeves are required for this operation. The 1/4-inch tap would be held directly in the drill spindle; the 10-24 tap should be driven by a floating sleeve which has the spring below the plug, so that the tap can float upward; and the 5/16-inch tap should be driven by a floating sleeve which has the spring above the plug, so that the tap can float downward.

An indirect advantage of the sleeve suggested in this article is that it can be used in regular shop practice as a tap-driver without float. At a cost slightly greater than that of a standard non-floating tap-driver, the suggested sleeves provide a driver that can be used as non-floating, or floating in either direction, as required.

Milling Fixture with Quick-Acting Wide-Opening Clamp

By H. B. FAUGHT, Burbank, Calif.

In order to mill a notch at *W* in the end of lug *C* on part *A* shown in the accompanying illustration, it was necessary to devise some means of exerting clamping pressure against lug *C* and also against surface *D*. The illustration shows the clamping arrangement designed for this purpose. The equalizing member *E* of the fixture enters opening *B* and clamps work *A* firmly in position on the locating block *F*. The full-line view shows the clamp in its closed position.



Quick-acting Fixture Used on Hand Milling Machine for Milling Notch W in Part A

To release the clamp, handle *G* is swung to the left, the open position being shown by the dotted outline. In operating the fixture, part *A* is placed on equalizing member *E* in the open position, as shown by the dotted outline at *X* in the plan view. Handle *G* is next swung to the right into the locked position, after which work *A* is fed vertically against the cutter. Equalizing member *E*, shown also in separate detailed views at the left, is made a slip fit in member *S* and in the opening in part *A*. Two separate views of part *S* are also shown at the left of the illustration.

Block *H*, which carries pivot-pin *I*, can be adjusted to compensate for wear by means of elongated slots in base *J*. Set-screw *K* is used to adjust block *H* and hold it in place. Pivot-pins *I* and *L* and link-pins *M* are made close sliding fits in the fixture parts and clamp to facilitate assembling, and are held in place by set-screws and cotter-pins, as shown. Spacing washers *T* are employed to locate handle *G* in the correct position. Blocks *N*, *P*, and *F* and brace *Q* may be arc-welded to base *J*, as indicated by the black fillets, or they may be held in place by screws and dowels. Two tongues *R* are provided in base *J* for aligning the fixture on the milling machine table.

* * *

There are two factors necessary in every successful enterprise—to know *what to do* and to know *how to do it*. This is one of the reasons why some men are executives and some specialists.

Gear Manufacturers Discuss Engineering and Business Problems

AT the twenty-third annual meeting of the American Gear Manufacturers Association, held at Hotel Cavalier, Virginia Beach, Va., a great many papers and reports were presented covering various phases of the gear-manufacturing industry from the engineering, metallurgical, and business points of view.

In his opening address, the president of the Association, Howard Dingle, president of the Cleveland Worm & Gear Co., reviewed a large number of the Association activities and briefly dealt with present business conditions. The business side of the industry was also ably dealt with in a paper by J. R. Fagan, of the Foote Bros. Gear & Machine Co., Chicago, Ill., entitled "Why the Chaotic Price Situation in the Gear Industry?"

C. F. Goedke, Newly Elected President of the Association

The manufacturing side of the gear industry was dealt with in several papers. J. R. Longstreet, of the Warner & Swasey Co., Cleveland, Ohio, spoke on "Turret Lathe Methods Applied to Small-Lot Gear Production." Dwight Van De Vate, of the Gleason Works, Rochester, N. Y., presented a paper on the "Surface Hardening of Gear Teeth," giving complete information pertaining to the flame-hardening process. The address on "Safety," by E. S. Sawtelle, of the Tool Steel Gear and Pinion Co., Cincinnati, Ohio, was also closely connected with the manufacturing side of the industry.

The metallurgical side was ably covered in two papers, "Gear Metallurgy," by E. J. Wellauer, of the Falk Corporation, Milwaukee, Wis., and "Materials for Worm-Gear Drives," by C. H. Bierbaum, of the Lumen Bearing Co., Buffalo, N. Y. The latter paper is published on page 692 of this number of MACHINERY.

Among other outstanding papers should be mentioned a review of engineering and design procedure from the drafting-room point of view, presented by G. R. Martins, of the Falk Corporation, under the title "Modern Drafting-Room Practice." G. L. Rothrock, of the General Motors Corporation, presented a paper on "Development of a Smaller Automobile Transmission," and R. G. De La Mater, of the Parkersburg Rig & Reel Co., read a paper on "The Application of Gear Reducers to Oil-Well Pumping Service."

Howard Dingle, Past-president of the Association

The subject of industrial mobilization was dealt with in two addresses—one by Colonel Harry B. Jordan, of the Ordnance Department of the United States Army, and the other by Hartley W. Barclay, editor of *Mill and Factory*. A report on "Plain Phenolic Laminated Pinions" was presented and accepted by the Association. In addition, a large number of progress reports were made by the various standardization committees.

The following four members of the Executive Committee were re-elected: John H. Flagg, president, Watson-Flagg Machine Co., Paterson, N. J.; F. H. Fowler, president, Foote Bros. Gear & Machine Co., Chicago, Ill.; C. F. Goedke, president, Ganschow Gear Co., Chicago, Ill.; and R. S. Marthens, manager of Gear Division, Westinghouse Nuttall Works, Pittsburgh, Pa. One new member, D. W. Diefendorf, vice-president, Diefendorf Gear Corporation, Syracuse, N. Y., was elected.

The following officers were elected for the coming year: C. F. Goedke, president of the Ganschow Gear Co., president; U. Seth Eberhardt, vice-president and general manager of the Newark Gear Cutting Machine Co., Inc., Newark, N. J., vice-president; and R. S. Marthens, manager of Gear Division, Westinghouse Nuttall Works, treasurer. J. C. McQuiston remains manager-secretary, with headquarters at 602 Shields Bldg., Wilkinsburg, Pa.

"Five-Point" Deephard Steel

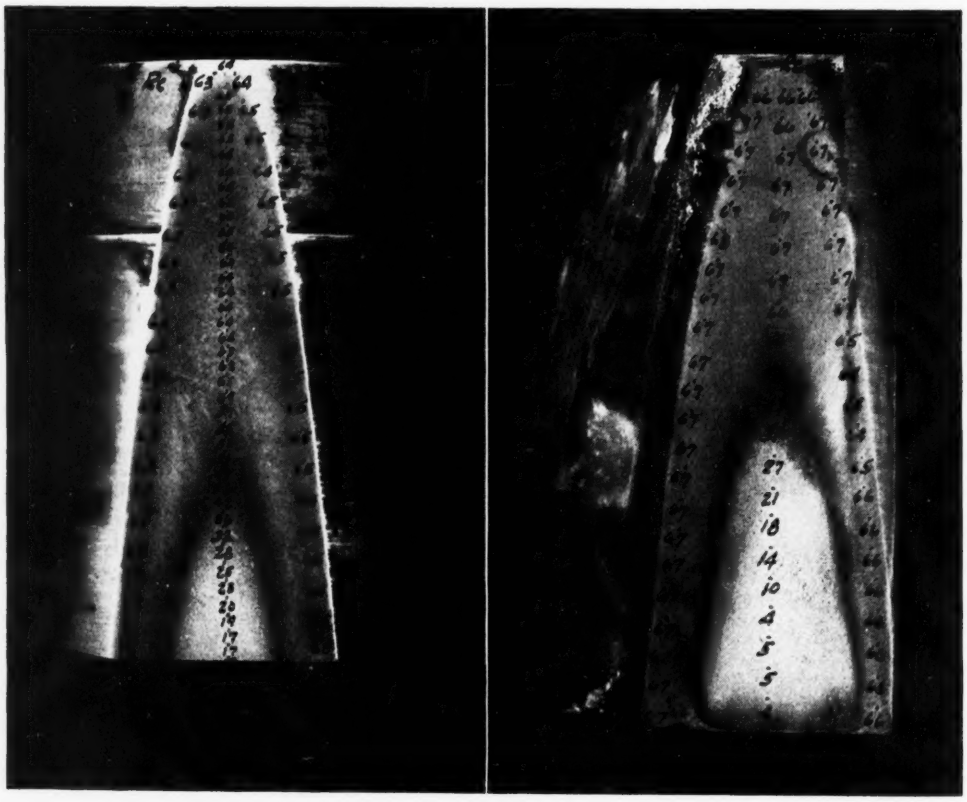
Description of the Unusual Wear- and Shock-Resisting Properties Obtained in Commercial Steels by the Application of a New Heat-Treating Process

An extensive research conducted by the Foote Bros. Gear & Machine Corporation into the problem of developing a steel hardening process which would produce consistently, in low-carbon steels, the best results in high surface hardness, depths of hardness, and gradual fusion of the hardened section with the core area, has resulted in what has been termed the "Five-point" Deephard steel process.

The manufacture of Foote Bros. products involves more than the simple problem of hardening the surface of small gears, shafts, and other parts with a light case from 0.020 to 0.030 inch thick, and once in a while 0.040 inch thick. Gears of all sizes, speed reducers, shafts, and other products are manufactured on a large scale. In addition to surface abrasion, a majority of these parts must withstand occasional unusually heavy or constant repetitive shocks, and heavy material stresses, all of which tend to induce spalling, fatigue, or impact failure in the presence of an imperfect grain structure or an insufficient bond or fusion between the hardness zone and the core area. These problems necessitate obtaining hardness depths of from 0.187 to 0.250 inch, the maximum surface hardness that can be obtained with a spall-resisting grain structure, and a gradual and even fusion of the hardened zone with the core area.

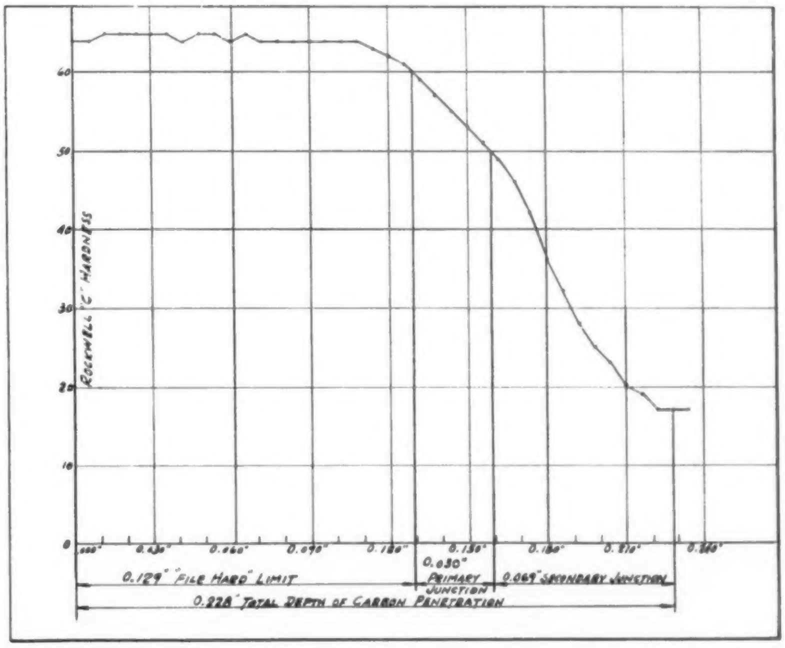
This concern also operates a contract department which manufactures work to the mechanical and heat-treating specifications of customers. This department is confronted with hardening specifications which steadily grow more stringent as to depth of hardness penetration, and high fatigue and impact resistance throughout the core area affected by the hardness. In both departments, distortion produced in hardening is a factor that must be considered in all work. It was believed, and this idea has been borne out, that this distortion could be reduced considerably by the use of a proper heat-treating process, even in the thinnest and most exposed sections, without sacrifice of the degree or depth of hardness.

The first step in considering the problem was to study and list those factors that control the manufacture of a successful "hard surface" product, which are as follows: (1) Degree of surface hardness obtainable; (2) uniformity of hardness



Figs. 1 and 2. Samples of S A E 1015 Steel Heat-treated by the "Five-point" Deephard Steel Process, Demonstrating the Uniformity Obtained in the Surface Hardness and the Gradual Change in Hardness from the Core to Outer Surface

Fig. 3. Diagram Indicating the Depth of Hardness Penetration on a 4-inch Diameter Bar of SAE 2315 "Five-point" Deephard Steel



throughout surface area; (3) grain structure of surface hardness; (4) depth of hardness obtainable; (5) self-supporting zone of hardness; (6) type of fusion or bond between the hardness zone and the core area, that is, gradual and even or with a clear line of demarkation indicating little or no fusion; (7) effect upon core area; (8) type of grain structure throughout.

Surface hardnesses obtained by the "Five-point" Deephard steel process range consistently from 60 to 68 Rockwell C., depending upon the analysis of the steel. This is shown in Figs. 1, 2, and 3. The degree of uniformity obtainable in the wearing surface hardness has been most satisfactory. Hardened surfaces 6 by 9 inches and larger have been tested over their entire surface with a Rockwell machine, and readings taken 1/2 inch apart in both directions. The maximum variance on any piece tested was two or three points, while in the majority of tests, the degree of hardness was even throughout the entire surface, as indicated in Figs. 1 and 2.

An outstanding advantage of the "Five-point" Deephard steel process is the control that it affords over carbon impregnation. A limit of 1.15 per cent carbon can be set throughout, although for most applications this content is restricted between limits of 0.93 and 1.10 per cent. This control enables specific wearing surface and core properties to be obtained.

Bearing in mind that the large percentage of service failures in "hard surface" products are due to unsatisfactory grain structure, every channel of effort that showed promise of consistent production of a refined and homogeneous grain structure was given a trial. From these efforts the present process was developed which shows a grain structure comparable in refinement to tool steel. As shown in the photomicrographs Figs. 4 to 8, inclusive, an ideal diffusion of carbon is obtained with no network of free cementite. It would appear from test data accumulated over a period of a year that it is possible to produce consistently a grain structure having from 5 to 15 per cent cementite embedded in a martensitic case. This type of structure is generally accepted as being ideal for wear resistence.

With impregnation periods shorter in duration than would be necessary with carburizing, depths of wearing surface hardness up to 5/16 inch are obtained. While no effort has been made to go beyond this depth, results indicate that this is entirely possible and would require no special technique or equipment other than a proportionate increase in the period of carbon impregnation. On the other hand, there are no difficulties in obtaining minimum depths of hardness, parts being heat-treated daily with hardness depths as light as 0.020 inch.

In the gradual drop of hardness and the even rate of its fusion with the core area that is obtained with the "Five-point" Deephard steel process, as illustrated in Figs. 1 and 2, a self-supporting zone of hardness is obtained which, in addition to strengthening the hardened part as a whole, acts as a support to the wearing surface zone of hardness and materially strengthens the latter. A major cause of spalling and impact or shock failure is eliminated; that is, the sharp and heavy drop in the carbon content from the hardness zone to the core area with no diffusion and consequently little or no bonding between the two sections.

The value of this diffusion and bond is graphically illustrated in Figs. 9 and 10, which show fragments from an S A E 4615 "Five-point" Deephard steel gear that was demolished in a breakdown test. The distortion that the teeth of this gear withstood before fracturing would not have been possible without this fusion and bond, and the manner in which the teeth eventually fractured, with each fracture going completely through the core structure, indicates a "hardened surface" steel product which, from a strength and service standpoint, is

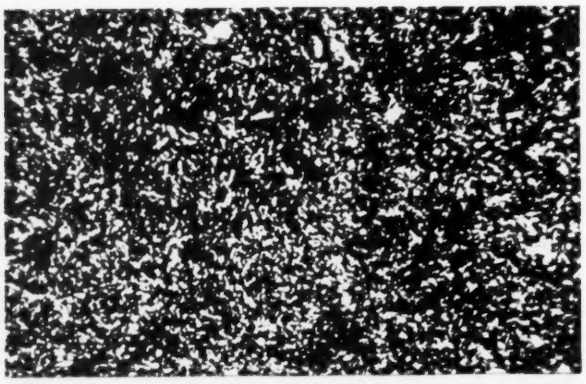


Fig. 4

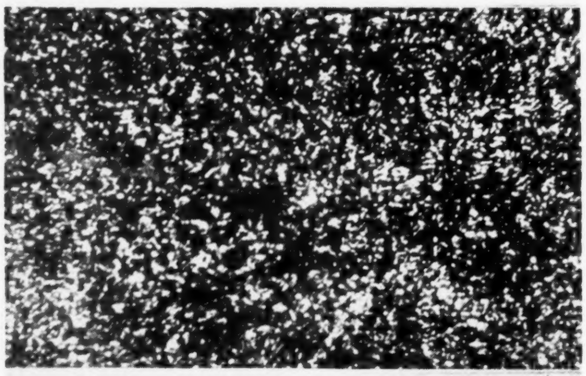


Fig. 5

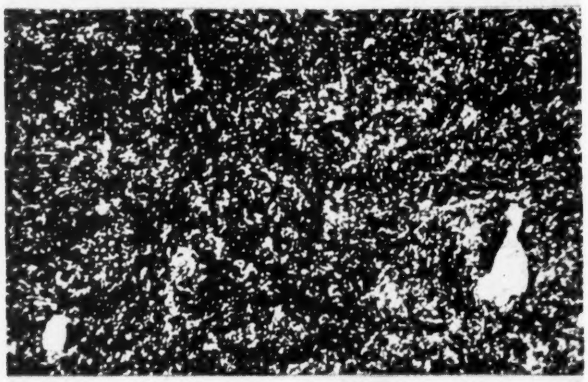


Fig. 6

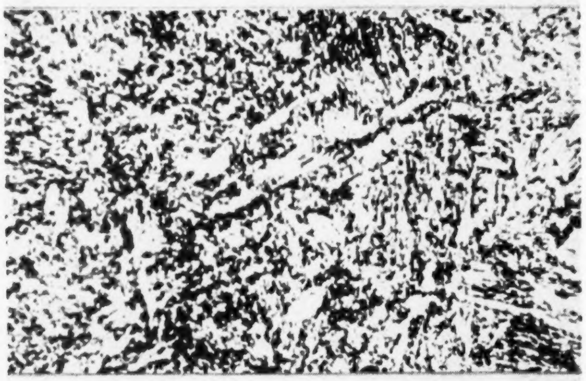


Fig. 7

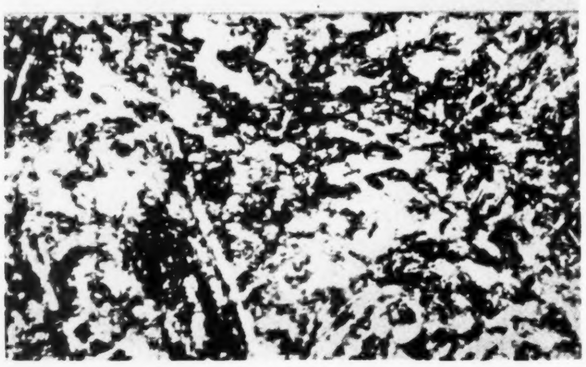


Fig. 8

a solid piece of steel rather than a steel having a case and a core.

In the heat-treating of work of such size and mass that the core is beyond the point of carbon penetration, the penetration of the area surrounding the core is such that higher strengths are obtained in the processed material as a whole. Consequently, the load and shock capacity of gears, and other small products having small and isolated sections subjected to heavy torsional and material stress, can be increased without fear of breakage from overstress.

With the "Five-point" Deephard steel process, it is possible to obtain in any low-carbon steel a fine and evenly grained martensitic or austenitic structure containing small spheroidized, evenly distributed carbides, this structure dropping off gradually into a homogeneous structure of pearlite, ferrite, and troostite, as may be seen from the photomicrographs, Figs. 4 to 8, inclusive. Metallurgically, the process results in a hypereutectoid steel in which the carbon penetration is uniform for two-thirds of the full depth. The change over to hypoeutectoid penetration is gradual and extends at least an equal distance beyond the file-hard hypereutectoid zone, as indicated in Figs. 1, 2, and 3.

Going beyond the development of the new heat-treating process and its application to all S A E low-carbon steels, the Foote Bros. Gear & Machine Corporation collaborated with a large mill in developing a steel of special analysis which, when hardened by the new process, would produce the maximum combination of high surface hardness and high strength. The result of this joint development is a nickel-molybdenum steel which, after being processed, shows the following physical properties as determined from the core of a 1-inch round sample: Yield point, 156,000 pounds per square inch; ulti-

Fig. 4. Grain Structure Refinement Approaching that of the Highest Grades of Tool Steel. (Taken at the Surface of Specimen)

Fig. 5. A Eutectoid Structure with a Refinement of Grain Seldom Seen in Commercial Steel. (Taken 1/16 to 1/8 Inch below Surface of Specimen)

Fig. 6. Homogeneous Junction of Spheroidized Pearlite with Small Areas of Unetched Martensite between the Deep "Wearing Surface" Zone and Core. (Taken 1/8 to 3/16 Inch below the Surface of the Specimen)

Fig. 7. A Structure that is Mainly Ferrite and Pearlite with a Refinement of Grain Size that Continues into the Core Structure. (Taken 3/16 to 1/4 Inch below the Surface of the Specimen)

Fig. 8. Finely Grained Ferrite and Pearlite Structure Somewhat Higher in Pearlite than the Original Bar. (Taken 1/4 to 5/16 Inch below the Surface of the Specimen)

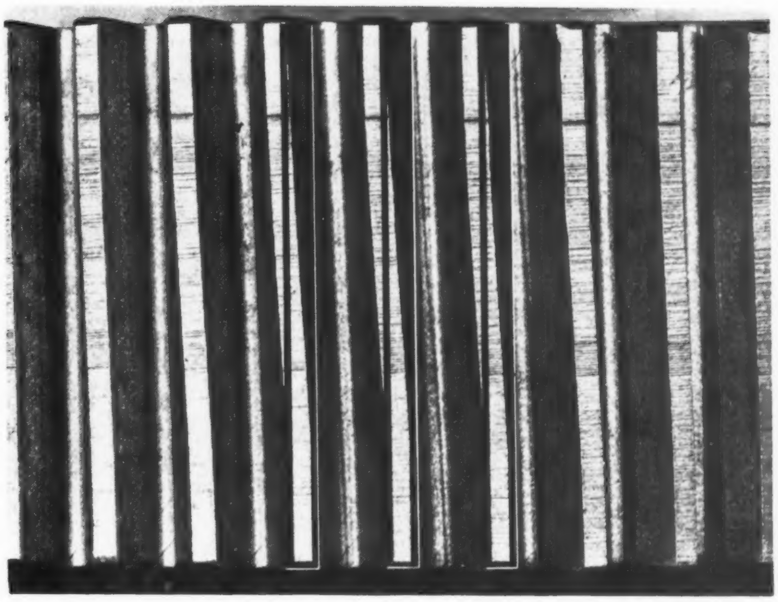


Fig. 9. Photograph in which Heavy Black Lines Indicate the Amount of Distortion (0.040 Inch) in the Teeth of a "Five-point" Deephard Steel Gear before Fracture Occurred in a Break-down Test

mate strength, 216,000 pounds per square inch; elongation, 11 per cent in 2 inches; reduction of area, 29.8 per cent; Izod impact test, 25; surface hardness, 725 Brinell; hardness of 1/4-inch outer section, 495 Brinell; and hardness of core, 429 Brinell.

Tests conducted on products manufactured from this special alloy and heat-treated with the "Five-point" Deephard steel process have indicated that where it is essential to have high surface hardness with high strength, the alloy is superior to high-carbon alloy steels having a range of from 275 to 325 Brinell. With a core hardness of 360 to 375 Brinell, gradually increasing to a surface hardness of 614 to 712 Brinell, this special alloy shows a shearing strength close to that of the strongest alloy steels and a degree of surface hardness that is higher than practical with those steels.

For example, SAE 4340 steel, 1.3 inches in diameter, and drawn to 800 degrees F., has a hardness of 440 Brinell and a tensile strength of 220,000 pounds per square inch, whereas a test specimen of the "Five-point" special alloy, 1.25 inches in diameter, had a core hardness of 360 to 375 Brinell, a surface hardness of 614 to 712 Brinell, and a core tensile strength of 190,000 pounds per square inch.

* * *

The Use of Machines and the American Standard of Living

The Machinery and Allied Products Institute, 221 N. LaSalle St., Chicago, Ill., has published an eighty-seven-page book entitled "Machinery and the American Standard of Living." This is the eighth pamphlet in the Institute's series dealing with important subjects related to industry. It is an illustrated collection of facts, showing the contribution of engineering and machine equipment to the American mode of life.

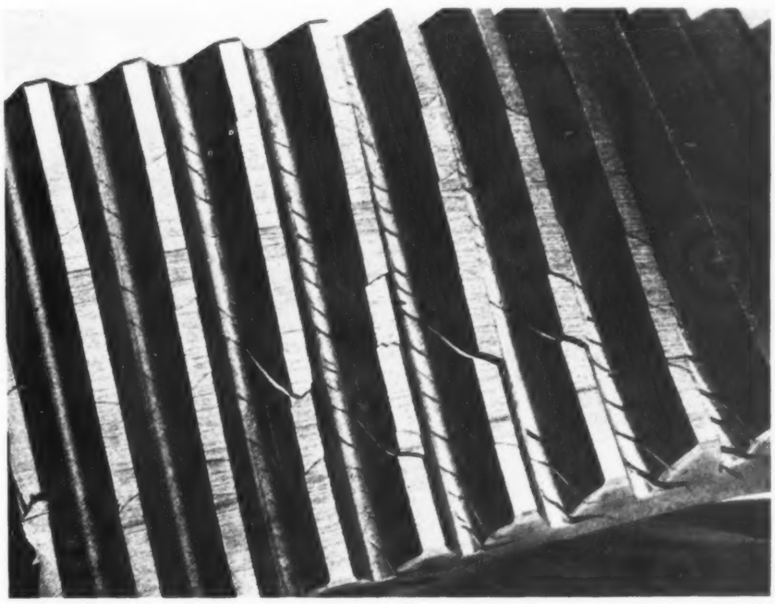
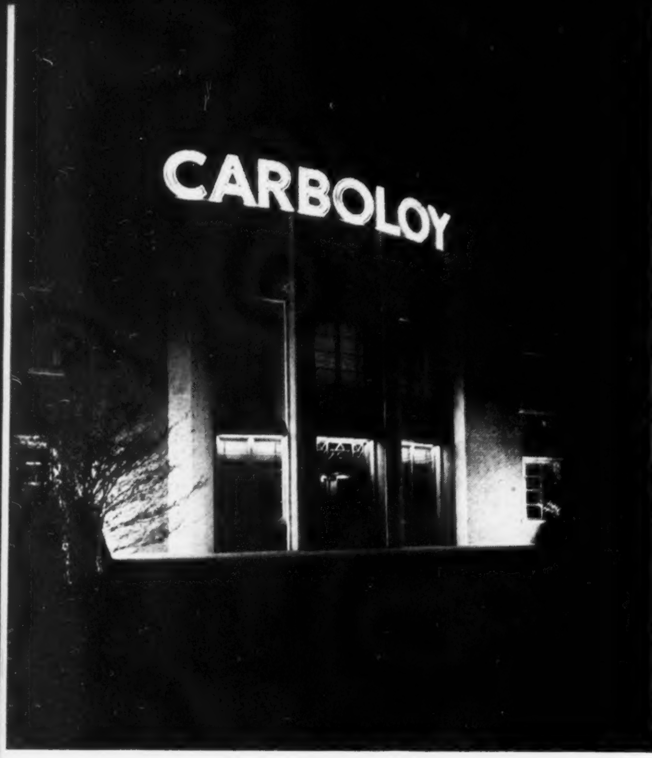


Fig. 10. In the Failure of the Gear Shown in Fig. 9, Every Fracture Extended into and through the Core without the Wearing Surface Flaking or Chipping



Carboloy Company Opens

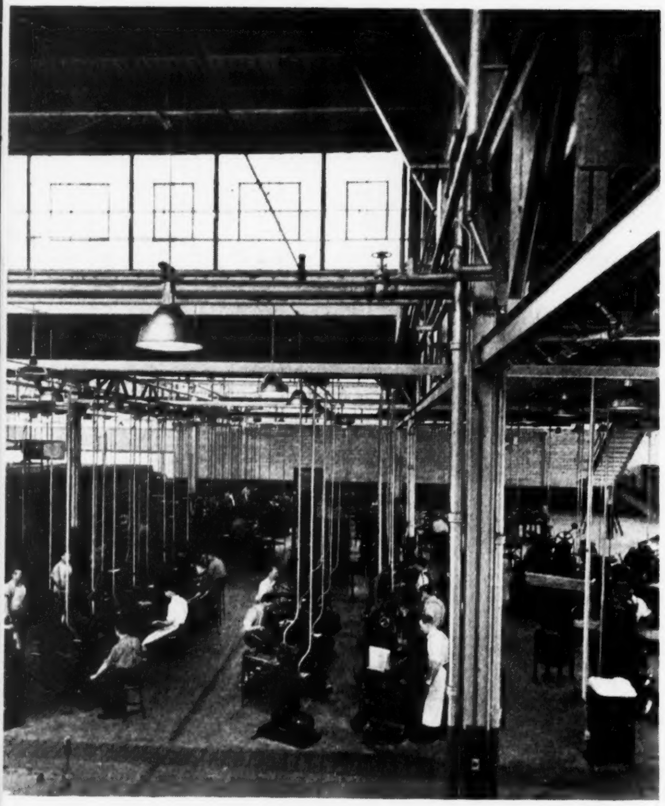
ON June 1, the Carboloy Company, Inc., formally opened its new plant and general offices in Detroit, Mich., consolidating all its manufacturing facilities for cemented-carbide products. This new plant embraces a total area of 122,000 square feet, combining, as it does, all the manufacturing facilities formerly divided among the company's plants in Cleveland, Ohio, Detroit, Mich., and Stamford, Conn.

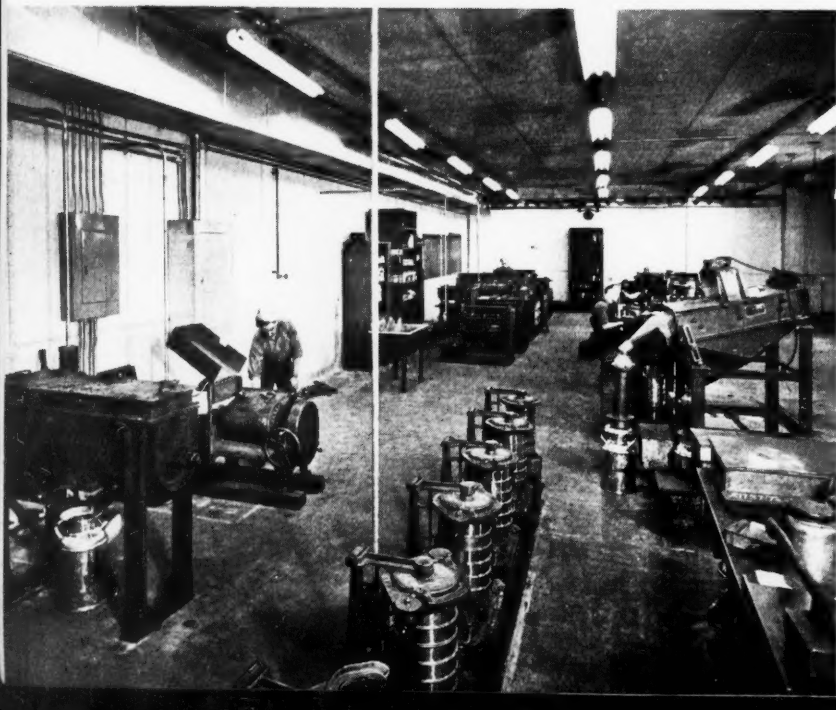
The new plant is designed for quantity production of cemented carbides. Its extensive facilities are an indication of the anticipated trend in the use of cemented-carbide tools and products. The equipment now installed, and that planned for future installation, is said to be capable of producing ten times the amount of Carboloy consumed by industry at present. There is also additional reserve space which will permit of future expansion of the present potential capacity if this becomes necessary. The plant is located on a forty-acre site situated on East Eight-Mile Road, one-quarter mile east of Van Dyke St., just beyond the outskirts of Detroit.

The two-story administration building, covering an area of about 35,000 square feet, houses all the general offices, including sales, engineering, drafting, purchasing, and accounting. This structure is of reinforced concrete, fireproof construction, and completely air-conditioned. The building has exceptional lighting facilities, departing, in several particulars, from conventional lighting methods. All illumination emanates indirectly from ceiling coffers, 4 feet square by 15 inches deep, providing from 25 to 40 foot-candles at the working plane of the offices. In the factory itself, greater light intensity is provided, some departments having up to 50 foot-candles at the working plane.

The factory building, which is connected with the rear of the administration building, is a monitor type one-story, all-welded steel and brick frame structure, covering an area of 88,000 square feet. It contains complete facilities for the manufacture of Carboloy, from the raw materials through to the finished tools, dies, and wear-resistant parts.

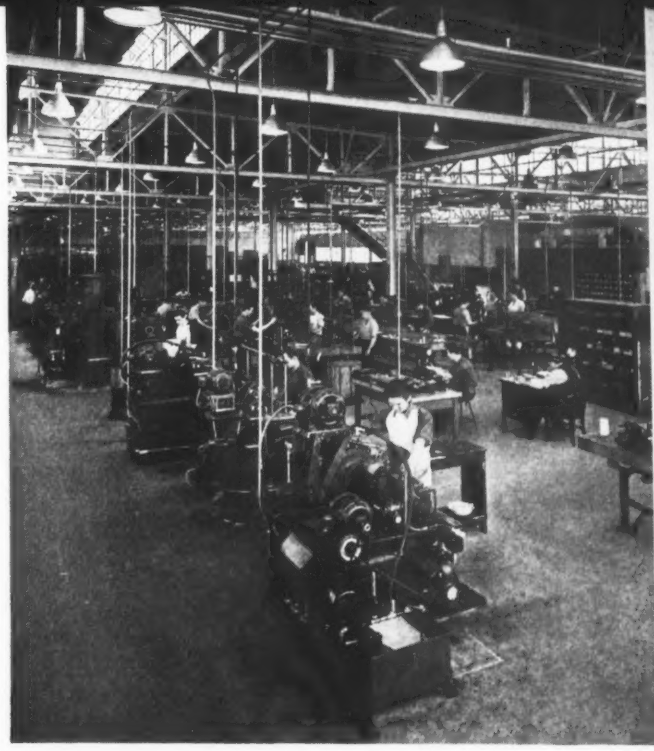
To control this production, as well as for the purpose of product development, a completely equipped research laboratory is provided. The importance of this laboratory is





(Top) Night View of the Entrance to the New Carboloy Offices and Factory in Detroit. This New Plant has a Total Floor Area of 122,000 Square Feet. (Center) Grinding Department in the New Carboloy Plant Equipped with Batteries of Hydraulic Surface Grinders, Internal and External Grinders, Cutter Grinders and Diamond Lapping Machines for Performing the Final Grinding Operations on the Tools. (Bottom) Powder Metal Room, Air-conditioned to Maintain Constant Temperature and Humidity for the Weighing and Blending of Materials Hydroscopic in Nature

New Manufacturing Plant



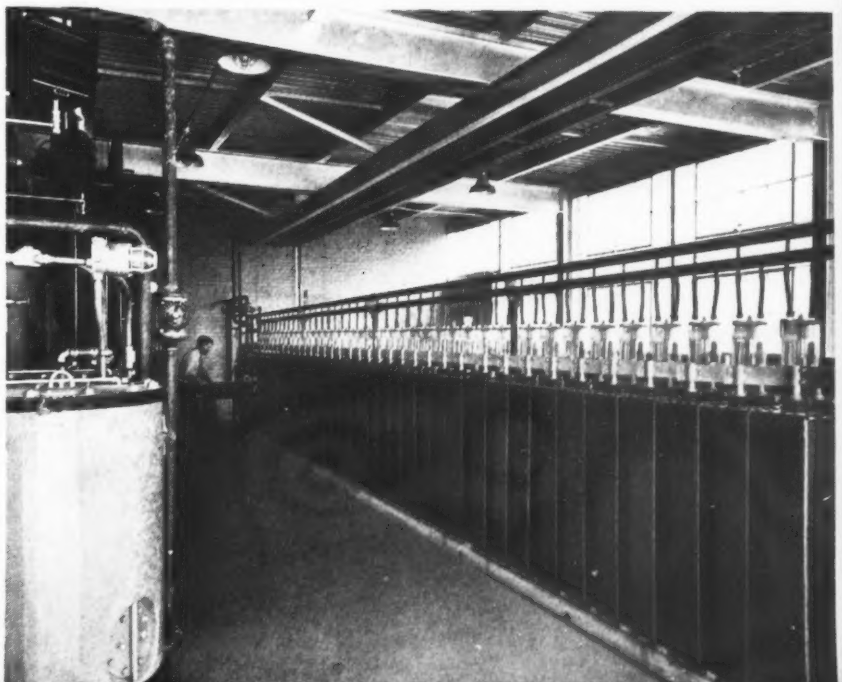
apparent from the fact that twelve tests are usually conducted at various stages in the production and processing of each new batch of Carboloy. A sample file, in which 500,000 grams of Carboloy, permanently identified for rechecking purposes, has been accumulated up to the present time, greatly aids in the accurate control of processing.

The main departments of the production plant are the powder metal department, the press room, the furnace room, the machining departments, and the inspection department. The powder metal department, or "metal room" as it is called, is air-conditioned to permit close control of the atmosphere in this section. Constant temperature and humidity are maintained here for weighing and blending of the powdered metals. From this room, the powdered metals pass to the press room, where two 300-ton presses provide for the production of ingots with maximum rectangular dimensions of 18 by 2 by 1 1/2 inches.

In the furnace room, eighteen furnaces are installed for the reduction, carburizing, semi-sintering, sintering, and brazing processes. Supplementing these, additional furnaces are installed in other departments for the brazing of tools and the hot-forging of die cases. Hydrogen is used for all processes requiring a non-oxidizing atmosphere in the processing furnaces. For this purpose, two generating units with a total capacity of 1250 cubic feet of hydrogen per hour are provided.

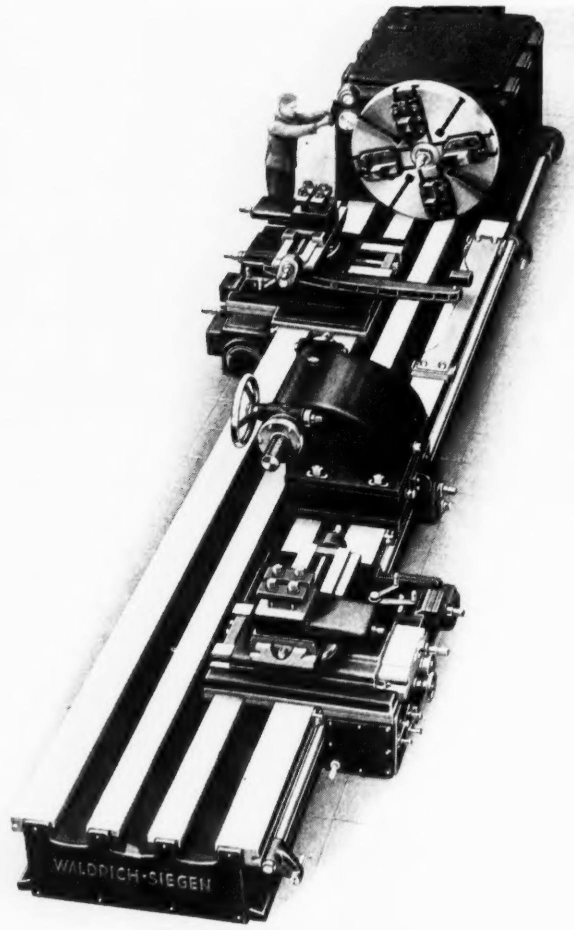
In the machining department, milling machines, grinding machines, lathes, cutting-off machines, and many special machines are installed for forming the rough semi-sintered ingots and blanks into the desired shape. The completely equipped inspection department provides for routine inspection operations, such as hardness testing, visual surface examinations, specification checking, etc. A projectograph, providing for a magnification up to thirty diameters, is available for some of these examinations, which supplement the check-tests made at various stages in the manufacturing operations.

The conveniences provided for the employes, including cooled drinking fountains; large, well lighted and well equipped washrooms; recreational facilities; and an employes' restaurant, are of a carefully planned modern type.

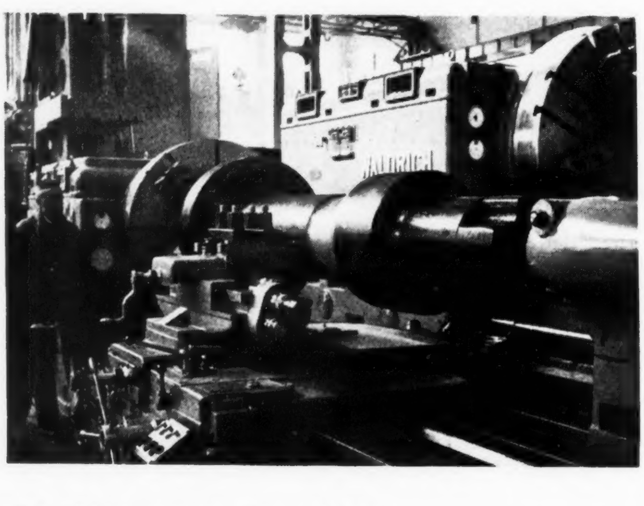


(Top) Interior View of the Plant, Showing Approximately One-third of the Factory Area. This Section Shows the Die, Grinding and Milling Departments. (Center) Furnace Room in the New Carboloy Plant Equipped with Eighteen Electric Furnaces for the Reduction, Carburizing, Semi-sintering, Sintering, and Brazing Processes. (Bottom) Hydrogen-manufacturing Room of the New Plant, Showing Equipment for the Production of Hydrogen with a High Degree of Purity. Two Generating Units Having a Total Capacity of 1250 Cubic Feet per Hour are Provided

Trends in Machine Tool Design as Noted at the Recent Leipzig Fair—2



Huge Form-turning Lathe Exhibited by the Waldrich Werkzeugmaschinenfabrik, Using Electric "Feeler" Control System for Duplicating External and Internal Profiles from Templets. Swing, 56 Inches in Diameter; Distance between Centers, 12 Feet. The Drive is by a 50-H.P. Motor. Below is Shown the Machine in Operation at the Leipzig Fair



IN the machine tool and accessory exhibits at the Leipzig Fair last March, there were, in all, 572 exhibitors, an increase of 11 per cent over 1938. There was an increase of 8 per cent in the area occupied by machine shop equipment exhibits. Engineers from every industrial nation in the world viewed these exhibits. A number of the machines shown are illustrated here, in order to give American machine tool designers an idea of the present trends in the German machine tool industry.

Since the German machine tool industry is working at capacity, there is, on the part of most of the machine tool builders, neither the incentive nor the necessity for bringing out radically new designs. Hence many of the machines exhibited were of designs seen in previous years. Still, in the exhibition as a whole, there were many new machines, and a great many improvements and refinements on older types of machines.

There is a scarcity of skilled mechanical labor in Germany, and as a result, it becomes necessary for the machine tool industry to provide equipment that is as simple as possible to operate and that reduces the necessity for judgment on the part of the operator. Safety devices are installed to prevent not only accidents to the operators but also damage to the machines. The photo-electric cell is used on several machine tools, particularly on power presses, for safe operation.

Indicating and inspection devices built in as part of the machines were in evidence to a greater extent than formerly. One thread grinding machine is provided with an optical device which makes it possible for the operator to see, on a screen, a greatly enlarged view of the edge or point of the grinding wheel and the thread, thereby facilitating setting of the wheel and inspecting of the cut.

Indicators that show at a glance speeds, feeds, etc., are quite commonly used. For example, on one radial drill there are three dial indicators—one showing the revolutions per minute at which the drill is running; another, the feed engaged; and the third, the pressure on the drill by the cut being taken. The same machine also has a circular scale back of the handwheel that moves the spindle up and down; this scale can be used for setting the drill to penetrate to a given depth of hole, at which point the drill is returned automatically.

A feature noted on several machines is what might be called a "slide-rule," usually circular, but sometimes in the form of a chart, which shows at a glance the relation between the drill diameter, speed, and revolutions per minute. Dials are also more and more being provided on turret lathes, milling machines, etc., showing directly the speed

and feed at which the machine is operating at the moment. A turret lathe was on exhibit on which all the speed changes are made instantly through the manipulation of push-buttons.

Indicators are employed on some machines to show the pressure of the cut against the tool. These give warning when the tool is dull and needs to be replaced by a sharpened tool. In one case, the pressure measuring device causes a red lamp to light when the pressure becomes excessive, and if the machine is not shut down after a certain length of time, it will stop automatically.

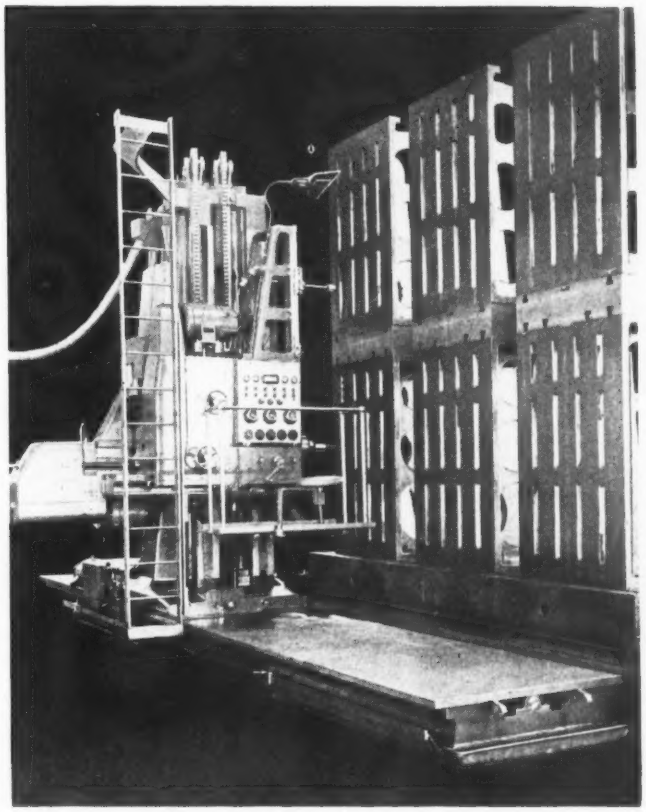
Spindle drives arranged to provide an infinite variety of speeds—that is, so-called "stepless" drives—are found on a great many machines. Separate motors for different functions of the machines are used to an increasing extent. On a large milling machine, for example, an individual motor for driving the milling machine spindle and a separate motor for the table feed are provided to eliminate mechanical connections and gearing between the spindle and the table feed.

The hydraulic arrangements on all types of machine tools are similar to the usual American practice, but there is possibly a greater tendency toward the use of electrical control than formerly, a very large number of machines, including standard types, being provided with push-button control. Electric control, however, does not seem to have replaced the use of hydraulic means when the latter is especially suited for the work. On one radial drilling machine, the arm is hydraulically clamped and the carriage is hydraulically clamped to the arm, the speed and feed changes also being hydraulically controlled.

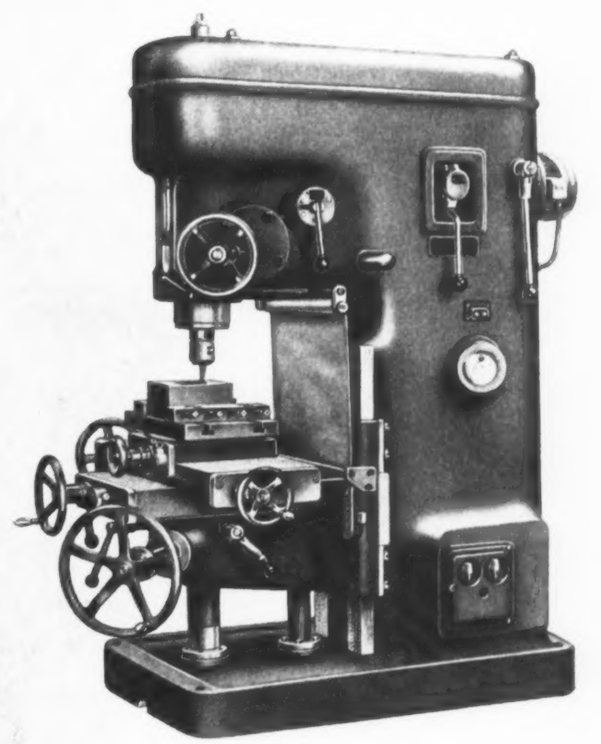
In the milling machine field, the automatic "oscillating" method of operation is in evidence, which reduces the idle time by keeping both the machine and the operator busy continuously. In this type of machine, two working stations are provided, one at each end of the table, and while the work held in the fixture of one station is being milled, the work at the other station is being loaded and unloaded. The table moves back and forth continuously and the spindle is constantly rotating.

Since the machine is cutting when the table moves in either direction, it is obvious that the spindle must reverse, and that two cutters must be employed, one right-hand and one left-hand, to suit the direction of the feed. Electric control, in conjunction with adjustable table dogs, is used for the automatic control of the table movements and the cutter rotation.

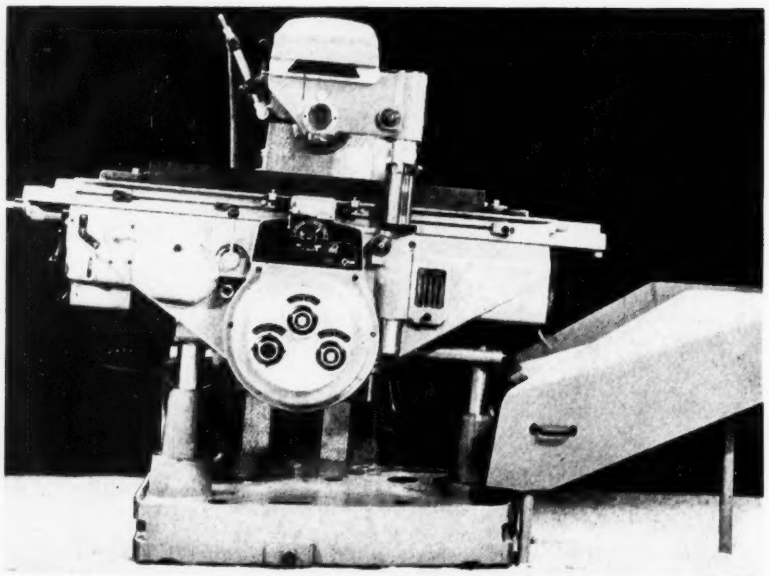
The climb-cut principle of milling seems to be used to an increasing extent. A gear-hobbing machine was on exhibit that had been especially designed for climb-milling, but that is also suitable for milling in the conventional manner. Two additional examples of climb-milling were seen, one a milling machine of somewhat unusual design intended exclusively for climb-milling, and the other a conventional type of machine adapted for both methods of milling.



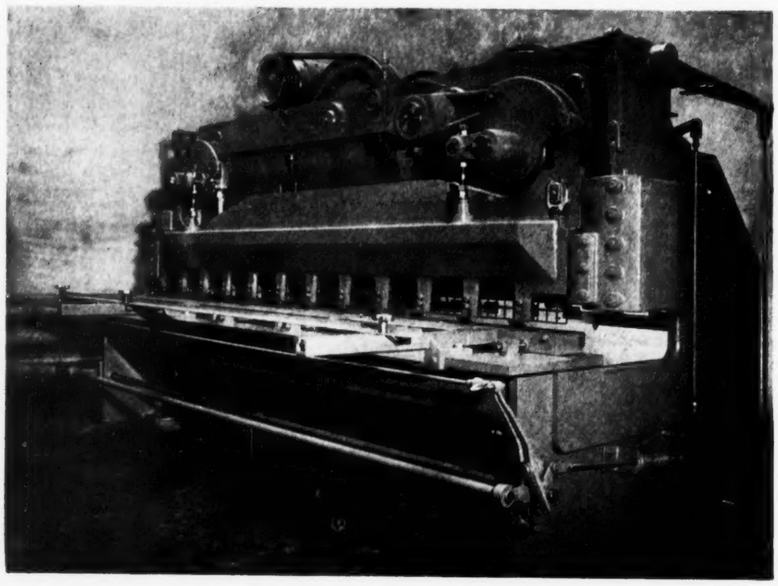
Automatic Electrically Controlled Duplicating Machine of Keller Type, Weighing 70,000 Pounds, Built by Collet & Engelhard. The Vertical Table for the Work and Former is 7 by 15 Feet



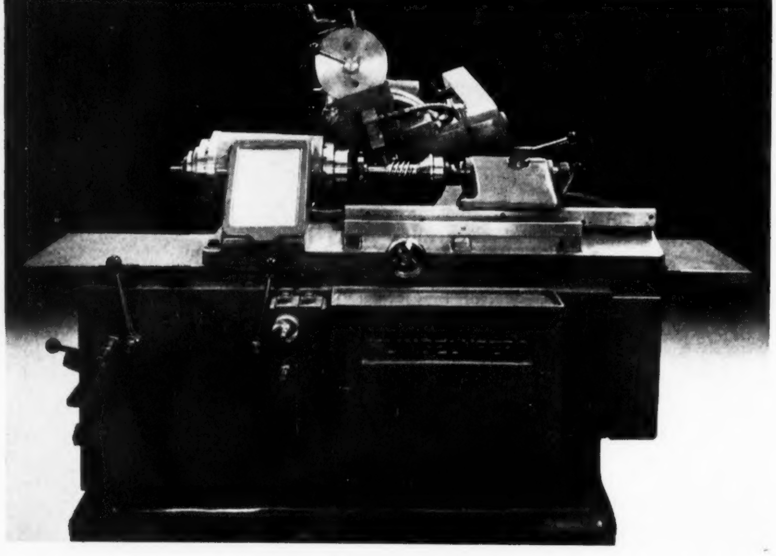
Mueller & Montag Die-sinking Machine of Modern Design, Now also Available with Electric Feeler Control for Duplication of Dies from a Master Form, with Depth of Cut Automatically Controlled



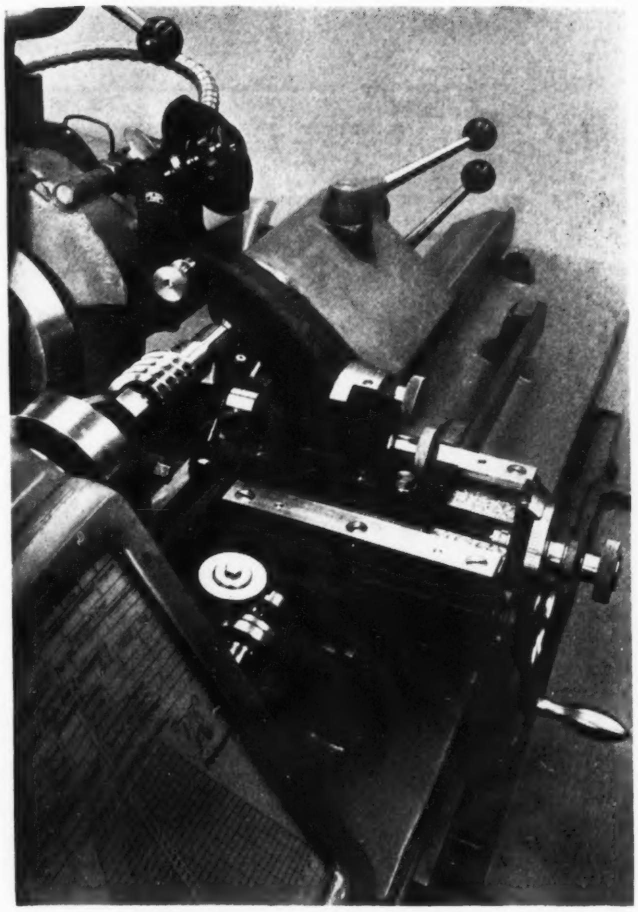
A Milling Machine Built by the Allgemeine Werkzeugmaschinen, A.G., Designed for Climb-cut Milling. Note that the Entire Machine Slants 5 Degrees to Facilitate the Removal of Chips and Cutting Fluid. The Two Vertical Supports of the Table Move in Unison, and are Inclined to Suit the Inclination of the Table



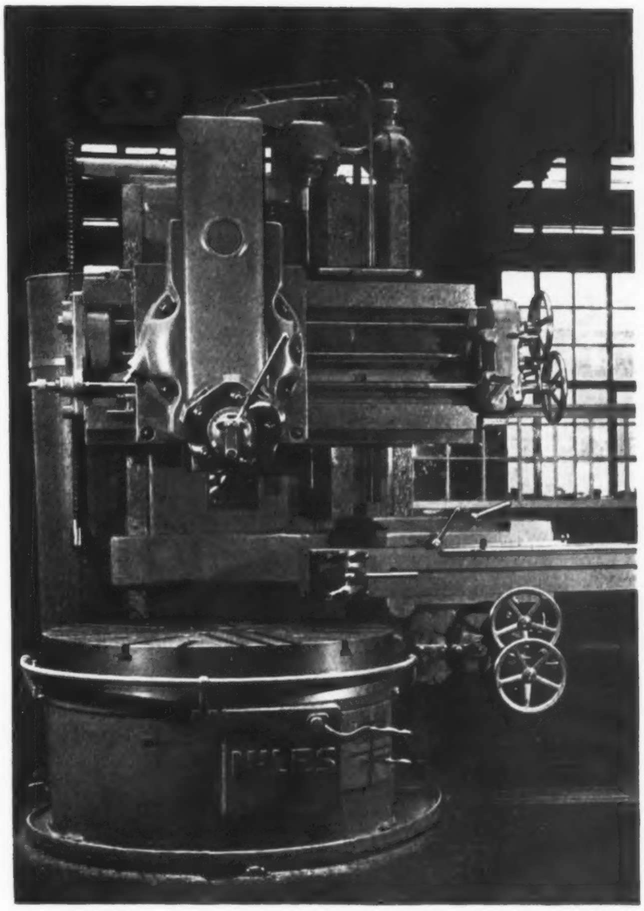
A "Guillotine" Shear Built by Henry Pels & Co. for Shearing Sheets up to 1/4 Inch in Thickness and 10 Feet in Length. The Shear is Provided with a Cutting Line Indicator for Setting the Sheets Accurately, and is Fitted with Effective Guards for the Operator's Hands and a Safety Device to Prevent Unintentional Operation



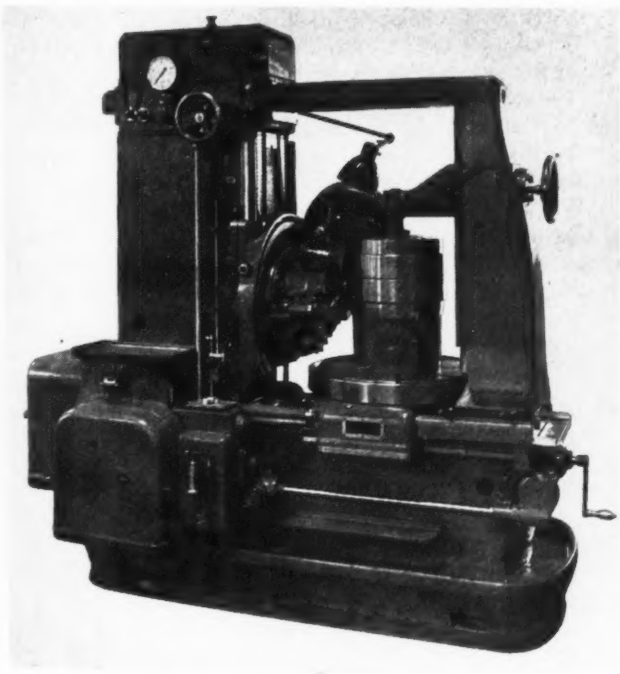
Klingelnberg Worm-grinding Machine Provided with Inspection and Gaging Equipment for Diameter and Thread Angle. The Machine Grinds (1) One Side of the Thread Advancing, Returning Idle; (2) One Side Advancing, and the Same Side Returning; (3) One Side Advancing and the Opposite Side Returning; and (4) Both Sides Advancing and Returning



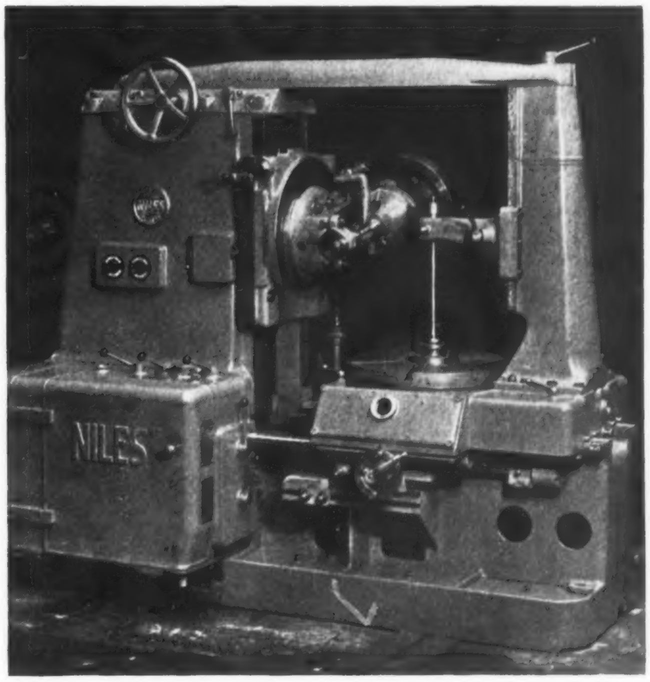
Worm Grinder Shown on Opposite Page, Provided with Optical Device for Inspecting the Ground Thread. Note Provision at the Left for Mounting the Drawing Giving Instructions for the Operation



Boring Mill of Modern German Design Exhibited by the Deutsche Niles Werke, Having a Capacity for Turning Work up to 5 Feet 8 Inches in Diameter. The Weight of This Machine is 46,000 Pounds



Pfauter Gear-hobbing Machine with an Attachment Adapting it for Climb-cut Hobbing; This Attachment can be Disengaged for Ordinary Hobbing Operations. The Machine Shown has a Capacity for Gears up to 40 Inches in Diameter



A Gear-hobbing Machine Built by the Deutsche Niles Werke, Provided with Several Innovations Aimed at Rapid and Accurate Operation. The Capacity of the Machine is for Gears up to 30 Inches in Diameter. The Weight of the Machine is 8300 Pounds

NEW TRADE  LITERATURE

Turret Lathes

GISHOLT MACHINE CO., 1209 E. Washington Ave., Madison, Wis. Performance data bulletins (with convenient binder) for foremen, production engineers, superintendents, and plant managers, giving performance data for Gisholt universal, heavy-duty, and automatic turret lathes on a variety of work in different plants, and actual savings effected. 1

Socket-Screw Drafting-Room Chart

PARKER-KALON CORPORATION, 202 Varick St., New York City. Drafting-room chart, containing data of value to users of socket screws. The chart gives threads per inch and various dimensions for different sizes of screws, quickly obtained by moving a circular disk. 2

Pneumatic and Hydraulic Equipment

HANNIFIN MFG. CO., 621-631 S. Kolmar Ave., Chicago, Ill. Bulletin 46, descriptive of Hannifin pneumatic arbor presses for assembling, broaching, straightening, bending, forming, etc. Bulletin 47, on Hannifin finger-tip pressure control for hydraulic presses. 3

Carboloy Tools

CARBOLOY COMPANY, INC., 11147 E. Eight Mile Road, Detroit, Mich. Booklet entitled "Hidden Profits in Your Machine Shop," describing the savings effected with Carboloy tools in different applications. Tool cost, comparative tool performance, and total savings are given. 4

Chains and Sprockets

BALDWIN-DUCKWORTH CHAIN CORPORATION, Springfield, Mass. Catalogue M, covering the complete line of chains and sprockets made by the company for power transmission, conveying, and elevating. Engineering data of value to designers and maintenance men is included. 5

Corrosion-Proof Coating for Metal Surfaces

AMERCOAT SALES AGENCY, 5905 Pacific Blvd., Huntington Park, Calif. Booklet describing the uses and application procedure for different types of Amercoat corrosion-resistant plastic coatings for metal, wood, and concrete surfaces. 6

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 715 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the June Number of MACHINERY

Heat-Treated Die-Heads

LANDIS MACHINE CO., INC., Waynesboro, Pa. Bulletin F-90, containing complete specifications, together with descriptive matter and illustrations, covering Landis heat-treated die-heads, which are made in three types to suit practically any type of thread-cutting machine. 7

Turret Lathes and Tools

WARNER & SWASEY CO., Cleveland, Ohio. Catalogue entitled "Down-to-Earth Facts on an Up-to-the-Minute Industry," showing numerous examples of the use of Warner & Swasey turret lathes in the production of various parts for the aircraft industry. 8

Precision Thread-Grinding Machines

EX-CELL-O CORPORATION, 1212 Oakman Blvd., Detroit, Mich. Bulletin 12591, illustrating and describing the construction details of Ex-Cell-O universal precision thread grinders, and showing the types and ranges of work that can be ground. Complete specifications for the styles 35 and 35L machines are included. 9

Air-Cooled Control Transformers

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Leaflet 75-030, descriptive of air-cooled control transformers designed for applications requiring circuit insulation and also to provide voltage changes for the operation of domestic and industrial apparatus. 10

Rexalloy Tool Bits

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Bulletin TS 400, on this company's new non-ferrous cast cutting alloy "Rexalloy," now available in tool bit form. Examples of increased speeds and deeper cuts made possible with Rexalloy are described. 11

Bakelite Plastic Materials

BAKELITE CORPORATION, 247 Park Ave., New York City. Booklet entitled "New Paths to Profits," intended to serve as a business man's guide to modern plastic materials, briefly describing various types of Bakelite and their possibilities for increasing sales and profits. 12

Hydraulic Broaching Machines

CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio. Catalogue M-834,, descriptive of the new Cincinnati single-ram vertical Hydro-Broach machines. Catalogue M-842, on Cincinnati vertical duplex Hydro-Broach machines. 13

Arc-Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Welding Specification Bulletin 314-A, descriptive of the Lincoln 150-ampere "Shield-Arc Junior" welder with self-indicating dual continuous control that provides any type or size of arc for low-cost welding. 14

Diemakers' Accessories

ALLEN MFG. CO., Hartford, Conn. Circular containing specifications, including prices, covering Allen "Tru-Ground" shoulder screws, hollow set-screws, socket-head capscrews, counterbores, "Tru-Ground" dowel-pins, and die springs. 15

Flexible Metal Tubing

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS CO., Waterbury, Conn. Bulletin SS-25, covering seamless flexible metal tubing for conveying steam, liquids, and gases, and for use in controlling vibration and in product design. 16

Stellited Valves

HAYNES STELLITE CO., UNIT OF UNION CARBIDE AND CARBON CORPORATION, 205 E. 42nd St., New York City. Reprint of an article entitled "Wear Reduction of Valves and Valve Gear" published in the S A E Journal. 17

Nickel Alloys

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Bulletin T-13, containing technical information on the use of nickel and nickel-base alloys in the design of corrosion-resistant machinery and equipment. 18

Wrenches

J. H. WILLIAMS & CO., 61 Lafayette St., New York City. Catalogue A-409, covering the Williams line of "Superrench" and "Supersocket" wrenches and tools. Circular descriptive of the torque "Measurrench" with reversible ratchet. 19

Speed Reducers

CHARLES BOND CO., 617 Arch St., Philadelphia, Pa. Circular descriptive of Bond B type double-reduction speed reducers with higher ratios and greater capacities. Leaflet listing Bond stock change-gears for lathes and other machine tools. 20

Precision Honing Machine

SUNNEN PRODUCTS CO., 7909 Manchester Ave., St. Louis, Mo. Bulletin PHG 676, descriptive of this company's Model MA four-speed precision honing machine for finishing internal cylindrical surfaces of small diameter. 21

Speed Chart for Kennametal Tools

MCKENNA METALS CO., 147 Lloyd Ave., Latrobe, Pa. Lathe chart, giving recommended speeds for cutting steels of any range of hardness with Kennametal, the new carbide tool bit tip material. 22

Twist Drills and Reamers

WHITMAN & BARNES, 2120 W. Fort St., Detroit, Mich. Catalogue 96, listing all types of drills, reamers, screw extractors, interchangeable punches, etc., made by the company. Information on the use and care of twist drills is included. 23

Slotting Attachment for Milling Machines

NEWARK ENGINEERING CO., Chestnut St., Hillside, N. J. Circular descriptive of a slotting attachment for milling machines, especially suitable for shaping out dies having sharp corners or odd shapes. 24

Dynamic Balancing Machines

GLOBE TOOL & ENGINEERING CO., Dayton, Ohio. Circular describing the new features of the Globe supersensitive dynamic balancing machine, with neon equipoise attachment. Bulletin 200A, entitled "How to Eliminate Vibration." 25

Welded Stainless-Steel Tubing

CARPENTER STEEL CO., Welded Alloy Tube Division, Kenilworth, N. J. Folder containing data on the analyses, shapes, finishes, and sizes of Carpenter welded stainless-steel tubing. 26

Sheet-Metal Shrinkers

ENGINEERING AND RESEARCH CORPORATION, Riverdale, Md. Bulletin illustrating and describing the Erco sheet-metal "shrinker," or upsetting machine, especially adapted for use in the aircraft industry. 27

Universal Milling Attachments

RIVETT LATHE & GRINDER INC., Brighton, Boston, Mass. Bulletin 130, illustrating and describing a new universal milling attachment designed for use on Rivett or other makes of precision bench lathes. 28

Universal Tool-Room Machine

HACK MACHINE CO., 440 N. Oakley Blvd., Chicago, Ill. Catalogue illustrating and describing the most recent design of Hack Multi-Versal, an all-purpose precision machine tool for making tools and dies. 29

Ferrous Castings

BELLE CITY MALLEABLE IRON CO. and RACINE STEEL CASTINGS CO., Racine, Wis. Bulletin showing appli-

To Obtain Copies of New Trade Literature

listed on pages 714-716 (without charge or obligation) mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

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24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46

Name .... *Position or Title* ....

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[SEE OTHER SIDE]

cations of four types of ferrous castings—steel, malleable, pearlitic malleable, and electric gray iron. 30

Electric Controlling Apparatus

ALLEN-BRADLEY CO., 1331 S. First St., Milwaukee, Wis. Circular illustrating fourteen installations of Allen-Bradley solenoid motor starters, where the operating conditions were of an exacting character. 31

"Ultra Keen" Cutting Tools

COGSDILL TWIST DRILL CO., INC., 6511 Epworth Blvd., Detroit, Mich. Bulletin descriptive of the method and equipment used in producing an "Ultra Keen" cutting edge on drills and other metal-cutting tools. 32

Hydraulic Pumps and Motors

W. A. RIDDELL CORPORATION, Bucyrus, Ohio. Catalogue descriptive of the Warco-Benedek hydraulic variable-delivery, high-pressure, radial pumps and motors, made in seven sizes. 33

Arc-Welding Machines

HOBART BROS. CO., Hobart Square, Troy, Ohio. Booklet entitled "The Fastest Selling Arc Welder on the Market Today," describing the features of Hobart arc-welding machines. 34

Drafting Machines

EUGENE DIETZGEN CO., 2425 N. Sheffield Ave., Chicago, Ill. Circular descriptive of the Excello free-floating drafting machine. Circular listing scales for use on all types of drafting machines. 35

Die-Heads

GEOMETRIC TOOL CO., New Haven, Conn. Bulletin CT-1, descriptive of the Geometric Style CT taper dieheads for use in hand screw machines, turret lathes, and similar equipment. 36

Power Press Brakes

COLUMBIA MACHINE TOOL CO., Long & Allstatter Division, Hamilton, Ohio. Bulletin 940-B, illustrating and describing the latest addition to the line of steel power press brakes made by this company. 37

Stiffness Gages

TABER INSTRUMENT CO., North Tonawanda, N. Y. Bulletin 3802, descriptive of the Taber improved V-5 stiffness gage for accurately measuring the stiffness of light metallic sheet and wire. 38

Roll-Grinding Machines

CINCINNATI GRINDERS, INC., Cincinnati, Ohio. Catalogue illustrating and describing the Cincinnati 36-, 44-, 50-, and 60-inch traveling wheelhead roll-grinding machines. 39

Tool Storage Equipment

LYON METAL PRODUCTS, INC., Aurora, Ill. Catalogue illustrating and describing the construction and use of the steel tool storage equipment made by this company. 40

Gear-Tooth Checking Machine

FELLOWS GEAR SHAPER CO., 78 River St., Springfield, Vt. Bulletin announcing a machine of radically new design for checking the involute profile of gear teeth. 41

Frequency Controllers

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Catalogue N-56-161(1), descriptive of the Micromax industrial type frequency controller. 42

Punch Presses

NIAGARA MACHINE & TOOL WORKS, 637 Northland Ave., Buffalo, N. Y. Bulletin 60-C, illustrating and describing the complete new Niagara line of streamline punch presses. 43

Visual Gages

SHEFFIELD GAGE CORPORATION, Dayton, Ohio. Circular announcing the Sheffield visual gage for checking a wide range of precision parts, both cylindrical and flat. 44

Tapered Steel Tubing

SUMMERILL TUBING CO., Bridgeport, Pa. Circular announcing tapered steel tubing with controlled wall thickness, especially applicable for use in aircraft. 45

Demagnetizing Equipment

BLANCHARD MACHINE CO., 64 State St., Cambridge, Mass. Circular descriptive of the Blanchard new adjustable-gap type demagnetizer. 46

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 717-733 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 717-733—or write directly to the manufacturer, mentioning machine as described in June MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

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[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Cincinnati Vertical Surface Broaching Machines

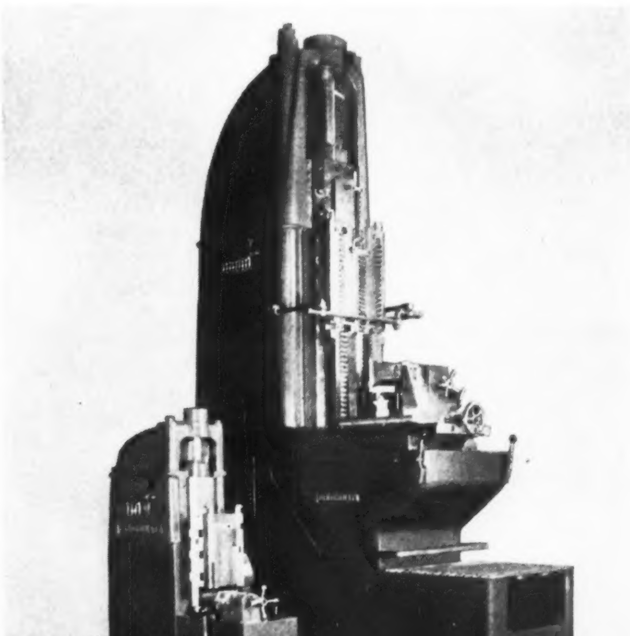
A new line of single-ram vertical "Hydro-Broach" machines has recently been added to the surface broaching equipment built by the Cincinnati Milling Machine Co., Cincinnati, Ohio. This new line includes twelve standard sizes; the smallest size machine has a ram stroke of 18 inches and a normal broaching force of 2000 pounds, while the largest size has a ram stroke of 60 inches and a broaching force of 30,000 pounds.

These machines are obtainable in both fixed- and receding-table types, and can be supplied in special sizes. The standard fixed-table machines are built for single-cycle operation, the ram stopping at the end of each stroke. The completed work is removed at the end of the cutting stroke, and new work is placed in the fixture while the ram is stopped at the top of its return stroke.

Either full-automatic or single-cycle operation can be employed on the receding-table type machine. In employing the full-automatic cycle, the work is loaded as the ram returns to the starting position after completing the cutting stroke. The table advances to the broaching position, the ram makes a cutting stroke, the table recedes, and the cycle is repeated. The table is returned to the exact broaching position within 0.0003 inch. For single-cycle operation of the receding-table type machine, the ram is stopped at the top of the return stroke and the operator unloads and loads the work.

Both the full-automatic and the single-cycle types can be stopped instantly by shifting the hand-levers at each side of the operating station or by depressing the foot-treadle. Instant reversal by means of dual hand-levers is also provided. These features are of great assistance to the operator in setting up or adjusting the machine. The operator's comfort and safety have also been carefully considered in designing the operating platform. The knee type construction has been developed to provide ample foot room, and the foot-treadle for stopping the machine instantly is extended the full width of the machine. In the single-cycle machines, two levers, which require the simultaneous use of the operator's hands, prevent starting the machine until both hands have been removed from the work or the cutting area.

Hardened and ground automatically lubricated table ways are furnished on the receding-table type machines. Interchangeable fixtures can be clamped quickly to a dovetail locating slide on the table. Directly under the operating platform of all sizes of the single-ram vertical machines, except the No. 1 size, there is a chip compartment from which the chips can be raked directly into a container by an attendant while the operator continues at work in his normal position without interruption.

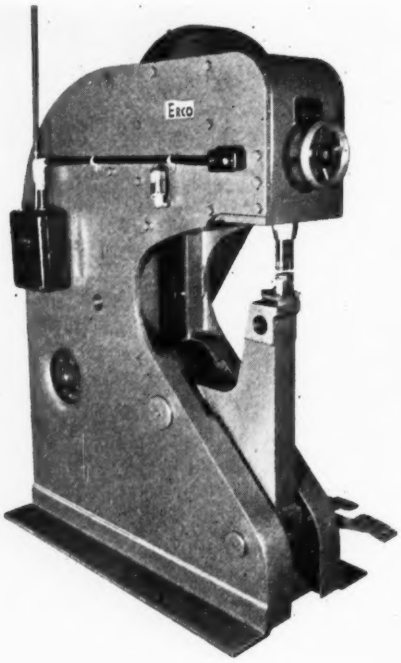


Cincinnati Single-ram Vertical Surface Broaching Machines

The constant-displacement hydraulic pumps are directly connected to the motor. A large radiating area facilitates oil cooling and prevents distortion from overheating. An automatic lubrication system is also employed on these machines.

The hydraulic-drive motor ranges from 3 H.P. for the smallest machine up to 30 H.P. for the largest. A speed-control valve for the ram can be built into the machines at the factory. The standard ram speeds are 41 feet per minute for the broaching stroke and 81 feet per minute for the return stroke on machines exerting a force of 2000 pounds. A broaching speed of 26 feet per minute and a return speed of 51 feet per minute are available on machines exerting a force of 30,000 pounds. 51

To obtain additional information on equipment described on this page, see lower part of page 716.



"Erco" Sheet Metal "Shrinker" for Forming and Fitting Aircraft Parts

"Erco" Sheet Metal "Shrinker"

A sheet metal "shrinker" or upsetting machine, designed primarily for use in forming and fitting various sheet-metal aircraft parts, has been developed by the Engineering and Research Corporation, Riverdale, Md. The two pairs of jaws with which this machine is equipped grip both sides of the sheet metal simultaneously and act upon it in such a manner that the length of the area gripped is reduced and the thickness increased. This action on the metal is just the reverse of that obtained with power hammers.

The machine can be used on mild and stainless steel, as well as on the aluminum alloys for which it was originally designed. It is, therefore, adapted for use in plants handling practically all kinds of sheet-metal work. It will perform such operations as bending rolled, formed, or extruded angles; bending formed channels and extruded tees; and producing double-curvature and spherical surfaces on sheet material.

The upper jaws of the machine are mounted on an anvil attached to the reciprocating ram, which is driven by a 2-H.P. motor in the machine base. The lower jaws are mounted on a similar anvil attached to the toolpost. The jaws are wedge-shaped pieces of tool steel that rest on inclined surfaces on the anvils. These jaws are normally held apart by coil springs. The down movement of the ram causes the jaws to grip the work at two points and then "upset" or force the metal together. 52

Bronze Welding Rods

Compressed Industrial Gases, Inc., 221 N. LaSalle St., Chicago, Ill., has just brought out two new bronze welding rods known as CIG No. 400 "Ready-Fluxed" bronze rods and CIG No. 401 "Ready-Fluxed" manganese bronze rods. As the names imply, these rods are flux-coated throughout their entire length, ready for application to oxy-acetylene welding work. These rods make it possible to introduce the chemically correct flux uniformly during the entire brazing operation, thus preventing the weld from getting too much or too little bronze.

The "Ready-Fluxed" bronze rods are designed for application in any type of bronze welding on all metals for which bronze is normally employed, without the use of additional flux. The "Ready-Fluxed" manganese bronze rods are particularly adapted for bronze welding cast iron. 53

Fellows Involute Measuring Machine for Checking Gear-Tooth Profiles

The Fellows Gear Shaper Co., 78 River St., Springfield, Vt., has just brought out a new involute profile measuring machine for checking gear-tooth shapes. This machine operates on an entirely different principle from any previously employed, the design being based on the fact that all involutes developed from the same base circle are alike. With the new machine, a single master cam is used for checking the teeth of any size gear within the capacity of the machine. The master cam takes the place of the "base roll" employed in previous machines, which required a different size roll for each size or diameter of gear tested.

The master involute cam of the new machine is developed from a base circle having a radius greater than that of the largest size gear accommodated by the machine. Thus, any gear having a smaller base-circle radius than the master cam can be checked by simply changing the position or radial distance of the pointer from the axis of the gear. The rate of travel of the slide that carries the indicator is changed automatically to agree with the base-circle setting. The machine has a capacity for testing gears having pitch diameters up to 6 inches. Both sides of the teeth can be checked in this machine without removing the gear.

The pointer that checks the involute is automatically set to the required base-circle radius by locating the main slide in the correct position by means of standard size-blocks. A size-block is also employed as shown in Fig. 2 for setting the pointer in the correct "radial" or "starting" position.

In cases where it is necessary to measure a modified form of involute, a graduated dial is employed which moves with the work, and, in conjunction with the dial indicator, measures the exact amount that the involute is modified and the angle through which the profile is modified. This device can also be employed for determining the height of the fillet and for checking the flanks of gear-shaper cutters. The machine can also be used to determine the base-circle diameter of a gear of unknown

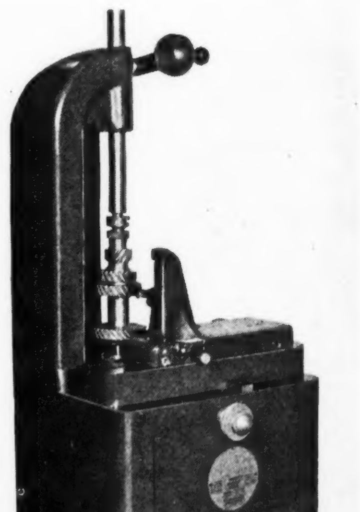
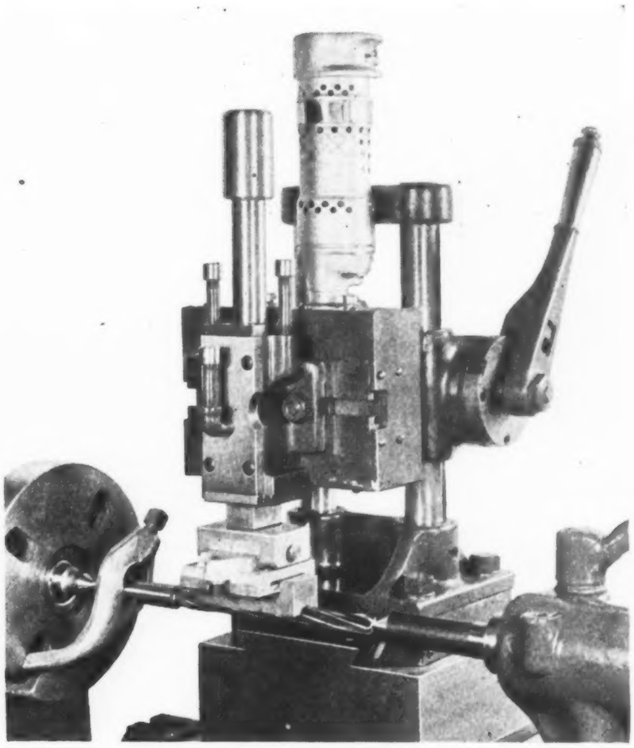


Fig. 1. Fellows Involute Measuring Machine

To obtain additional information on equipment described on this page, see lower part of page 716.

Fig. 2. Setting Involute Pointer on Fellows Gear-tooth Checking Machine



Machine Equipped for Performing Cogsdill "Ultra Keen" Edge-surfacing Operation

origin or specifications. This feature is useful in making replacement gears.

Only two settings are necessary in checking the involute profiles of the teeth on any of the four gears comprising a cluster of gears, such as shown on the machine in Figs. 1 and 2, and no special equipment or parts are required. The only dimension necessary is the base radius, and, when this is given, no calculations are required. 54

Cogsdill "Ultra Keen" Edge-Surfacing Process for Cutting Tools

The Cogsdill Twist Drill Co., Inc., 6511 Epworth Blvd., Detroit, Mich., has developed a new edge-surfacing process known as "Ultra Keen," which can be applied to ground, honed, or lapped surfaces of hardened cutting tools to obtain a superior cutting edge. With this new method, the "Ultra Keen" edge is obtained by a combination of short motions, light abrasive pressure, slow abrasive cutting speeds, hard abrasives, and lubricants of the proper viscosity.

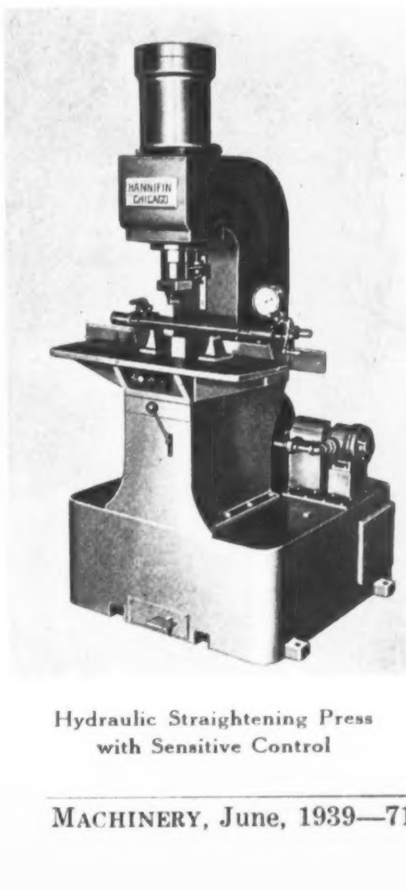
As several motions are necessary with this process, specially designed finishers have been developed that have a variable multi-motion action. With this method, the abrasive literally "wears" a metallic surface to crystalline smoothness, thus eliminating surface defects caused by preceding mechanical operations in removing the defective metal surface known as "grinding fuzz." 55

Hannifin Straightening Press with Sensitive Control

The Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., has developed a new type of sensitive pressure control for use on the hydraulic presses made by this company for straightening, forcing, assembling, and similar work. The machine illustrated is a 20-ton, high-speed straightening press equipped with both hand- and foot-lever control.

The new control provides for an unusually rapid operating cycle with finger-tip or light foot control of the ram movement on the advance stroke, and of the ram pressure during the working stroke. The ram movement, both up and down, and the pressure control are accomplished by means of a single hand-lever or foot-pedal. Thus, any required working pressure on the ram, up to the capacity of the press, can be obtained by simply moving the control lever. Releasing the control lever at any point automatically returns the ram to the top position at high speed.

In making forced fits, the pressure can be held between predetermined limits by watching the indicator of the pressure gage. Two adjustable hands on the gage can be set to indicate maximum and minimum pressure limits. An adjustable stop is provided to prevent exceeding the maximum pressure limits. 56



Hydraulic Straightening Press with Sensitive Control

To obtain additional information on equipment described on this page, see lower part of page 716.

Acme Eight-Spindle Coupling Tapper Equipped with Lead-Screws

A completely redesigned, 2-inch, eight-spindle coupling tapper developed for high-speed operation has just been placed on the market by the Acme Machinery Co., 4535 St. Clair Ave., Cleveland, Ohio. Lead-screws with split nuts that automatically open after the couplings have been completely tapped insure an accurate thread and give positive lead to the tap as it enters the coupling. Air chucks are employed, which are controlled by valves that are operated automatically by the downward movement of the spindle.

In operating this machine, the coupling is put in the chuck, the tap is lowered to the work, and the lead-screw nut is locked. As the tap is lowered to the coupling, air is automatically admitted, causing the chuck to close on the coupling. The action of the lead-screw then causes the tap to feed through the coupling at the rate corresponding to the pitch of the thread being cut. Just after the last thread of the tap leaves the coupling, the continued downward movement of the spindle again operates the air valve, causing the chuck to open, after which the lead-screw nut is opened automatically, allowing the counterbalanced spindle to return to its upper position with the tapped coupling on the shank of the tap.

When the tap shank has become filled with couplings, they are emptied into a chute at the rear of each spindle. A new type quick-acting ring socket makes it possible for the operator to unload the work while the spindle is rotating.

Speed changes are obtained by pick-off gears. The machine can be changed quickly to suit various sizes of couplings. When a taper coupling is to be tapped, the machine is equipped with air-operated cross type roll-over chucks and collapsible taps. Thus equipped, the machine will also tap straight couplings, the roll-over feature of the chuck being locked, so that the chuck cannot be rotated. 57

Rotor "Powerplus" Grinders

The Rotor Tool Co., 17325 Euclid Ave., Cleveland, Ohio, has brought out four new air grinders, each built around the new "Powerplus" twin-cylinder air motor developed by this company. The D-75 grinder of this new line is designed to use cone and 4-inch wheels; the D-80, regular 4- and 6-inch wheels; the D-100, heavy-duty 6-inch wheels, including 13-inch and 26-inch extensions; and the D-300, heavy-duty 8-inch wheels. The first two grinders in this line weigh 8 1/4 pounds, while the last two weigh 9 3/4 and 11 1/4 pounds.

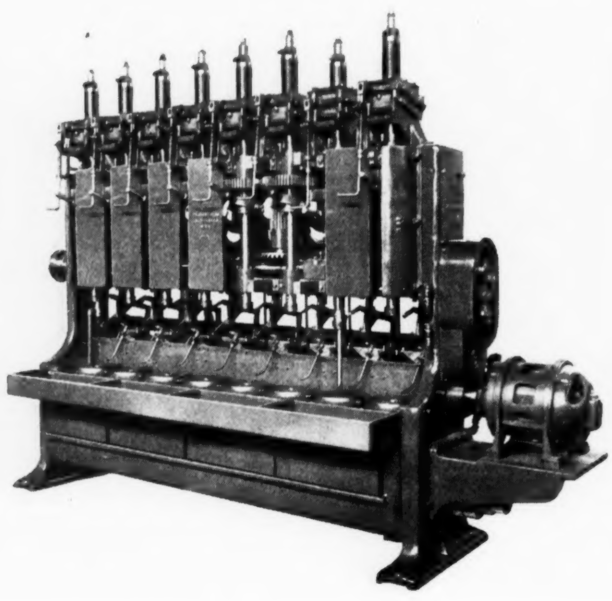
The new air motor is of the external blade type originally developed and patented by this company. The rotors, end plates, twin cylinders, center bearing section, positive lubrication system, and multi-port safety balanced governor are of improved design.

These grinders are designed to operate at high speed under load and to reduce wheel costs. Their light weight facilitates operation, and the low air consumption is a feature that tends to reduce the power cost. The grinders can be easily disassembled for cleaning and servicing. The operation of the new governor is not affected by varying air pressures.

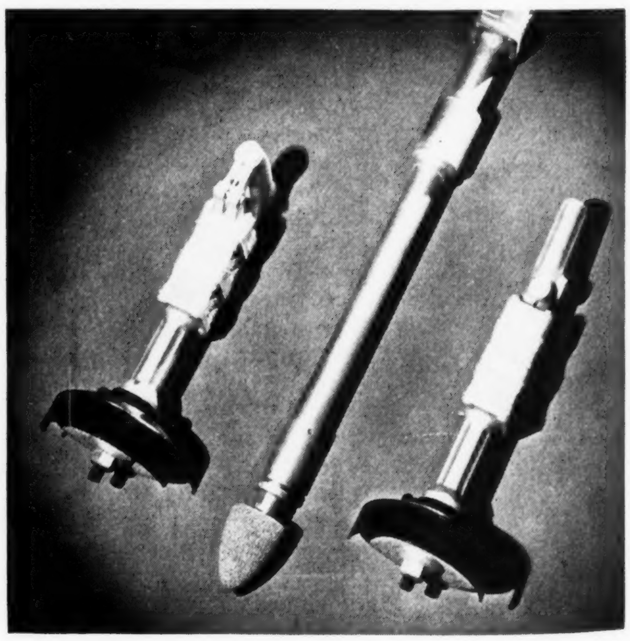
These grinders are available with straight, spade, and safety straight handles. The "Powerplus" grinders are distinguished by twin red bands on the cylinders. The complete line of four machines has been so designed that repair parts are interchangeable, which serves to keep the maintenance cost at a minimum. The front and rear handles, center bearing sections, end plates, etc., are also interchangeable. Parts that seldom need replacing, such as the twin-cylinder section, rotors and blades are not interchangeable. 58

Brown & Sharpe Centrifugal "Motorpump"

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently added a No. 207 centrifugal "Motorpump" to its line of pumps for supplying coolant to machine tools and light



Acme Eight-spindle Coupling Tapper Built for High-speed Operation



D-100 "Powerplus" Grinders and Extension Made by the Rotor Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 716.

machinery where dirt or abrasives may be present in the liquid and where a moderate volume of liquid is desired at a low head. This new Motorpump is similar in general performance to the No. 206 pump described and illustrated in January, 1938, MACHINERY, page 349, except that it has a greater depth of submergence. The submergence depth of the new pump is 12 7/16 inches, whereas the previous models had submergence depths of 6 3/4 and 9 15/16 inches. The No. 207 pump is especially adapted for installation in deep tanks or in places where the liquid is much lower than the mounting surface. 59

Blanchard Adjustable-Gap Demagnetizer

A demagnetizer that produces an intense alternating magnetic field between its poles for demagnetizing articles placed in the gap and slowly withdrawn is made by the Blanchard Machine Co., 64 State St., Cambridge, Mass. Heavy high-speed steel tools can be completely demagnetized in a few seconds with this machine, and it can be used to demagnetize several hundred small pieces, held in a wire basket, the entire operation requiring less than half a minute.

The non-magnetic metal tray or shelf supports the work and protects the demagnetizer from water and dirt, so that it can be used for demagnetizing pieces that come directly from a wet grinding machine. The current is turned on and off by a contactor controlled by a knee-operated button.

The demagnetizer is usually wound for use on 110- or 220-volt, 60-cycle, single-phase alternating current, but it can be wound for use with currents of other voltages. Direct current, however, cannot be used. The gap is adjustable from 1 to 6 inches, and the throat depth from the center of the poles to the vertical part of the core is 8 inches. The over-all dimensions of the demagnetizer are: Length, 25 1/2 inches; width, 23 5/8 inches; and height, 26 inches. The weight is about 325 pounds. 60

Reliance Adjustable-Speed Motor Drive

An all-electric, alternating-current, adjustable-speed drive that employs a principle of speed control previously used only on large units has been developed by the Reliance Electric & Engineering Co., 1042-1090 Ivanhoe Road, Cleveland, Ohio. This drive is intended for machine tools, textile machines, and equipment requiring an adjustable-speed drive operating on alternating current.

It consists of a control unit connected to the alternating-current distribution circuit which furnishes direct current for an adjustable-speed motor applied directly to the driven machine. This speed-changing combination is designed to provide an economical means of varying the operating speeds of small motors from

Fig. 2. Speed Adjuster and Push-button Station of Reliance Adjustable-speed Drive

1 H.P. up, where only an alternating-current power supply is available and where the change in the speed range may be as high as 12 to 1.

The speed control unit has been designed for use on three-phase, 60-cycle, 220-, 440-, and 550-volt alternating current. This unit is of vertical construction, occupies a minimum floor space, and can be mounted in any convenient location in the shop.

The complete drive, as applied to the automatic feed of a 16- by 120-inch cylindrical grinding machine is shown in Figs. 1 and 2, the control unit and the motor being shown at *A* and *B*, respectively, in Fig. 1. The speed adjuster and the start and stop buttons are shown at *C* and *D*, respectively, in Fig. 2. The latter controls are mounted at the front of the machine close to the other control buttons and handles. This particular installation provides a 4 to 1 range of speed adjustment. 61

Blanchard Demagnetizer Used to Demagnetize Several Hundred Small Parts Held in Wire Basket

Fig. 1. Reliance Adjustable-speed Control Unit and Adjustable-speed Motor Applied to Grinding Machine

To obtain additional information on equipment described on this page, see lower part of page 716.

"Junior" Broaching and Assembling Press Built by Colonial Broach Co.

Colonial "Junior" Broaching Presses

A new line of small broaching and assembling presses has been brought out by the Colonial Broach Co., Detroit, Mich., to meet the requirements for low-cost hydraulic presses suitable for broaching small parts and for miscellaneous light assembly work. The machines in this line are controlled by a single hand-lever, and are similar in practically every detail to the larger machines made by this company.

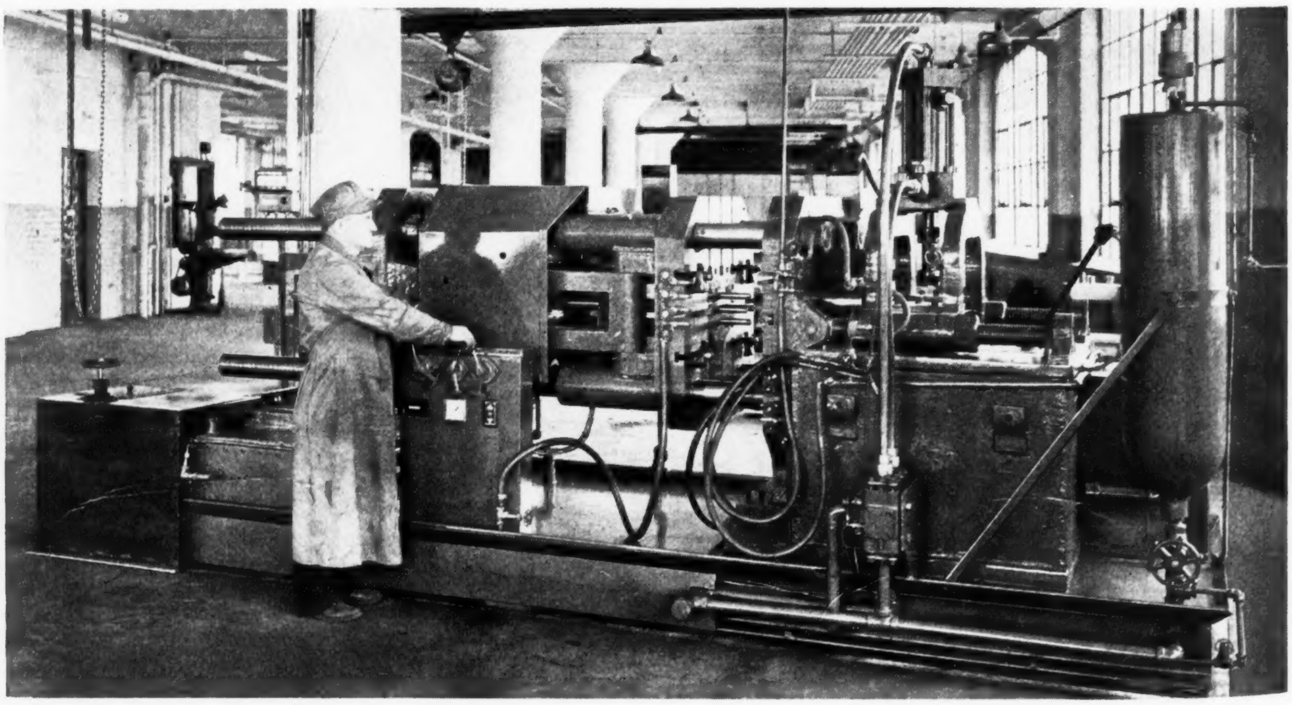
These "Junior" machines have an over-all height of 31 inches, a capacity rating of 1/2 ton, and a stroke that is adjustable up to 10 inches. The platen is 8 by 12 inches, and there is a clearance of 5 inches between the ram and the machine frame. The equipment includes a built-in oil tank with sight-gage, and a hydraulic pressure pump with direct-drive motor. The weight is approximately 750 pounds. 62

Hydraulic Self-Contained Pressure Die-Casting Machine

A pressure die-casting machine designed for the production of zinc, aluminum, and brass alloy die-castings, is being manufactured by the Dycast Products Division, Monarch Aluminum Mfg. Co., Detroit Ave. and W. 93rd St., Cleveland, Ohio. This Model 200 machine has a die opening of 12 inches, a maximum die space of 32 inches, and a minimum die space of 12 inches. It has a production capacity of 600 "shots" per hour at pressures up to 6000 pounds per square inch for zinc, and 16,000 pounds per square inch for aluminum and brass. The press has a locking pressure of 250 tons. The capacity of the melting pot is 750 pounds of zinc and brass, or 250 pounds of aluminum. The machine is operated by a 7 1/2-H.P. motor. It occupies a floor space of 60 by 186 inches, and weighs approximately 18,000 pounds.

With each machine are included a pyrometer, heating unit for the metal, electric motor, valves for water lines, Veeder counter, oil-pump unit, filters or strainers in lines where necessary, shut-off valves at important places in oil and water lines, and all necessary wrenches. A simple arrangement permits installing the plunger in a few minutes, a feature that means a substantial saving in time. An improved gooseneck design is used to give the machine long life and provide economical operation.

An over-size oil-pump unit and motor are furnished to insure ample power and pressure at all times. The rigid, welded construction of the base prevents the machine from "weaving," and serves to keep the dies in accurate alignment. The operator has a visible means of checking the flow of water through all the water lines. A "deoxidizer," which is standard equipment on zinc alloy machines reduces the dross to a minimum. A complete unit, with a cold chamber arrangement into which the metal is ladled, is available for the high-pressure die-casting of aluminum and brass alloys. 63



Pressure Die-casting Machine Brought out by Dycast Products Division, Monarch Aluminum Mfg. Co.

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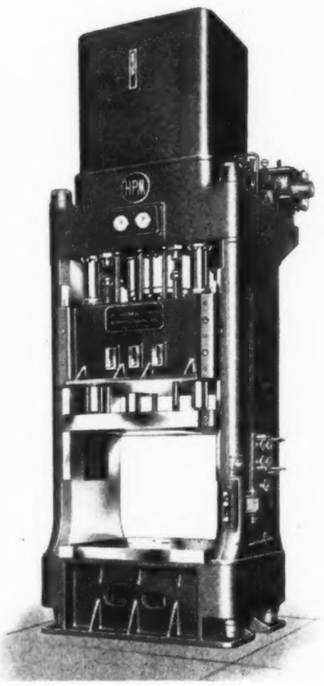


Triple-action Deep Drawing Press Developed by Hydraulic Press Mfg. Co.

"Fastraverse" Triple-Action Deep Drawing Press

A new "H-P-M Fastraverse" triple-action press, with "smooth-lined" styling designed to harmonize with the most modern plant equipment, has been developed by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio. The piping, wiring, and control linkage are concealed, and all control stations and gages are flush-mounted. There are three separate hydraulic sections for operating the main draw punch, the blank-holder ring, and the die bottom of the regulation triple-action drawing die.

The machine has a pressure capacity of 425 tons on the main ram for single-action service; 300 tons on the main ram for triple-action drawing service; 150 tons on the blank-holder; and 50 tons on the die cushion. The pressing areas are 60 by 60 inches for the main slide, and 60 by 60 inches for the over-all blank-holder slide, with a center opening 35 by 35 inches for the die cushion.

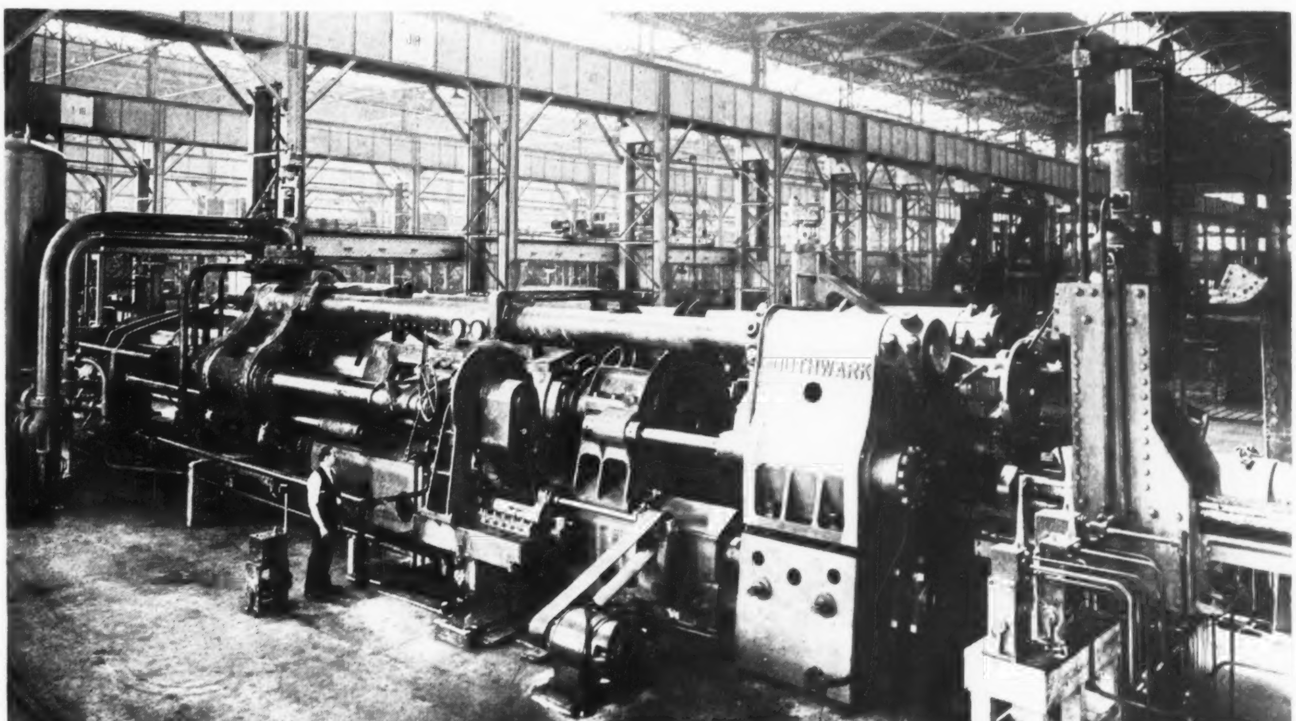
A unique characteristic of this triple-action press is the operation of the second and third hydraulic actions for the blank-holder and die-cushion functions without additional sources of hydraulic power. The power of one radial pump, applied first through the main press ram, is distributed through other groups of rams to the blank-holder slide and die cushion, the force exerted by each of these members being regulated independently of the others or of the main ram tonnage.

An important feature is the provision for varying the blank-holder pressure at each of the four corners. This adjustment is particularly useful in drawing pieces of irregular contours, where the blank must be held with greater pressure at certain points. Four pressure adjustments for the four blank-holder rams, with a separate gage for each, are located on a panel at one side of the machine. A fifth adjustment and gage are provided for the die cushion. 64

Huge Baldwin-Southwark Extrusion Press

A huge extrusion press having a capacity of 4500 tons, which will handle billets up to 24 inches in diameter by 36 inches long, has been built at the Eddystone, Pa., plant of the Baldwin-Southwark Corporation. This machine has a working stroke of 7 feet, and is designed for both direct and indirect extrusion work. The ram is 59 inches in diameter, and operates under a pressure of about 3200 pounds per square inch. The press is of the four-rod type, with forged tension rods 16 inches in diameter, weighing over 25,000 pounds each. The main cylinder casting weighs 200,000 pounds.

Two powerful coarse-tooth saws driven by 40-H.P. motors are provided for cutting-off operations. A total of 900 H.P. is developed by all the motors required to operate the machine. The press is operated by two multiple-plunger hydraulic pumps which deliver 200 gallons per minute at a pressure of 3200 pounds per



Extrusion Press of 4500-ton Capacity Designed to Handle Billets 24 Inches in Diameter by 36 Inches Long

To obtain additional information on equipment described on this page, see lower part of page 716.

square inch. These pumps are used in connection with a hydro-pneumatic accumulator system. Two high-pressure accumulator containers, which have an inside diameter of 4 feet and a height of 30 feet, with walls 5 inches thick, and which weigh 10,000 pounds each are employed.

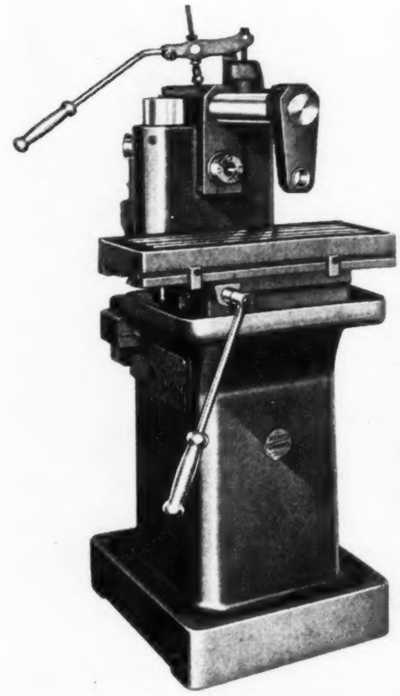
The machine alone weighs over 1,000,000 pounds, and the auxiliary equipment weighs about 500,000 pounds. 65

South Bend 14 1/2-Inch Lathe

A new line of lathes having a swing of 14 1/2 inches is being introduced on the market by the South Bend Lathe Works, 775 E. Madison St., South Bend, Ind., for use in toolrooms, machine shops, and production departments of large plants. The lathes in this line have specially designed attachments that adapt them for duplicate manufacturing operations, fine tool and gage work, and a variety of jobs. They have been designed with a view to obtaining smooth, silent operation, lasting accuracy, and easy control. They are made in motor-driven and countershaft-driven types, in five bed lengths of from 5 to 10 feet, with between-center distances of from 24 1/2 to 84 1/2 inches, in both quick-change-gear and standard change-gear types.

Some of the more important specifications of the new lathes are: Swing over saddle, 10 1/4 inches; thread-cutting range of the quick-change-gear model, 4 to 224 threads per inch, and of the standard change-gear model, 4 to 160 threads per inch; 32 right- or left-hand longitudinal feeds ranging from 0.0015 to 0.021 inch for the quick-change-gear model, and from 0.002 to 0.021 inch for the standard change-gear model; cross-feeds ranging from 0.0006 to 0.0078 inch in the quick-change-gear lathe, and from 0.0008 to 0.0078 inch for the standard change-gear lathe.

The hole through the headstock spindle is 1 1/8 inches, and the collet capacity, 3/4 inch. The six spindle speeds range from 22 to 657 R.P.M. A metric lead-screw and metric graduations can be furnished. Attachments for manufacturing operations include a hand-lever type draw-in collet chuck, hand-lever tailstock, hand-lever double tool-slide, turret attachment, and four-way toolpost. The tool-room attachments include a handwheel type draw-in collet chuck, telescopic taper attachment, micrometer carriage stop, thread dial indicator, electric grinding attachment, and milling attachment. 66



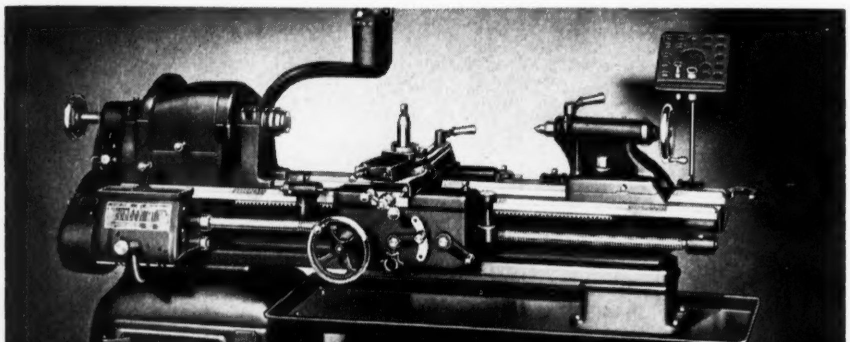
Kent-Owens Hand Milling Machine Designed for a Wide Range of Milling Work

Kent-Owens Hand Milling Machine

The hand milling machine here illustrated, which is designed for a wide range of light and medium milling operations, is built by the Kent-Owens Machine Co., Toledo, Ohio. This new machine (the No. 1-M) is a distinct departure from the conventional hand miller design and provides many advantages not previously available in machines of this class. A new twin-post construction is employed to carry the head, the spindle being located midway between the posts. The entire head is counterbalanced by a long adjustable coil spring with self-compensating lever connection, so that the weight of the head and the tool equipment offers practically no resistance to the feeding movement imparted to the head. This counterbalance is fully adjustable to compensate for any variation in weight due to changes in the tooling, over-arm, or pendent. The cylindrical post construction is designed to provide a bearing for the head that eliminates chatter.

The table is 9 by 25 inches, and has a total movement of 12 inches, a 180-degree rotation of the feed-lever being sufficient to produce a feeding movement of 4 3/4 inches. The table has three T-slots and its travel is limited by two adjustable dogs. The table and head control levers are adjustable for front or rear operation, and also for length.

The elimination of both the saddle and the knee has materially increased the rigidity of the machine. Speed changes are made by means of pick-off gears at the rear of the head. Speeds of 100 to 1335 R.P.M. are available with a 1200 R.P.M. motor, or a maximum of 2000 R.P.M. can be obtained with an 1800 R.P.M. motor. The spindle has a No. 30 National Standard nose and taper, and is mounted on two precision taper roller bearings in front and a preloaded ball bearing at the rear, all running in an oil bath. 67



South Bend Lathe Made in Five Bed Lengths

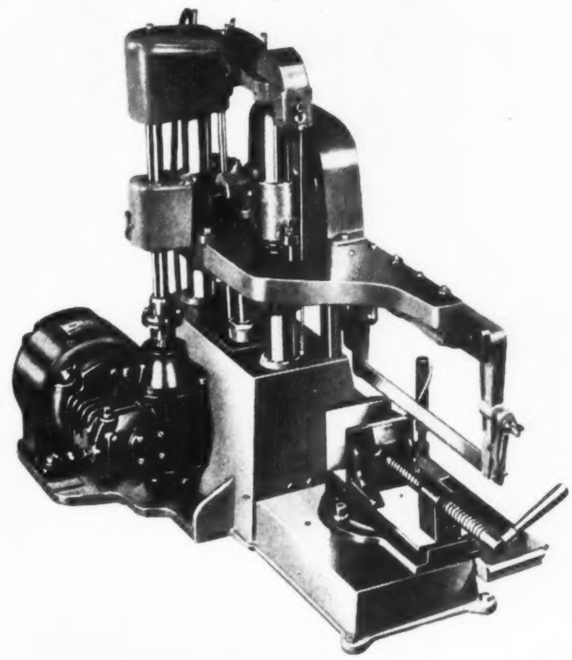
To obtain additional information on equipment described on this page, see lower part of page 716.

Master Portable Hacksaw

A portable power hacksaw that can be set up in any part of the shop or carried anywhere for use on the bench or floor has been placed on the market by the Master Machine Co., 872 W. North Ave., Chicago, Ill. This machine is equipped with a powerful machine vise, mounted on a swivel base which is graduated to 45 degrees. The jaws of this vise can be opened to take round stock 7 inches in diameter or square stock of an equivalent size. Round stock up to 5 inches in diameter can be cut at an angle of 45 degrees. The machine will also cut thin-walled tubing without bruising or tearing.

An outstanding feature of this machine is that it will cut material of the size specified without the use of a coolant or overheating of the saw blade. The saw stroke can be adjusted to suit requirements, and is maintained at a steady speed of 108 strokes per minute. Hydraulic pressure applied automatically serves to lift the saw to any desired position, from which point it cannot descend until the pressure is released. When the saw reaches the lowest point of its downward feed, it stops automatically. From this point, it is raised by hydraulic pressure when the current is turned on.

This machine occupies a floor space of 27 by 41 inches, and is 34 inches high. It weighs 457 pounds, and is driven by a 1/2-H.P. motor. 68



Master Hacksaw Equipped with Vise Mounted on Swivel Base

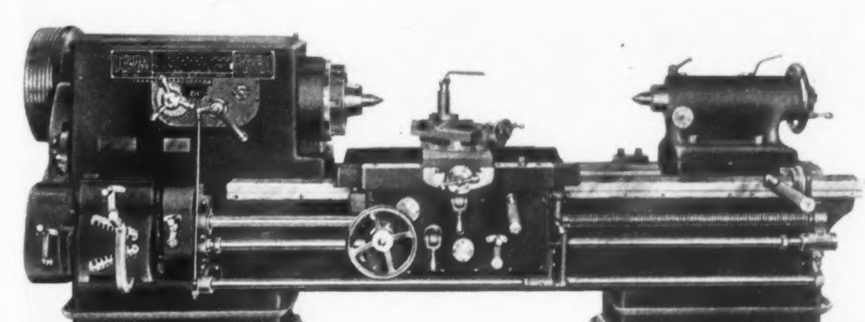
"Hydratrol" Lathes Built for Heavy Duty

Hydraulic lathes in sizes from 24 to 36 inches are now being built in an extra heavy-duty type by the Lehmann Machine Co., Chouteau and Grand Blvd., St. Louis, Mo. Various features have been incorporated in the design of these lathes to obtain efficient operation with a minimum of effort. Any of the sixteen spindle speeds, for example, can be obtained by simply turning one handle on the front of the headstock. This handle also operates a slide-rule arrangement at the same time, which gives the spindle speed in revolutions per minute and the cutting speed in feet per minute for any diameter of work.

The over-size hydraulic driving clutches are self-compensating and require no adjustment. No manual pressure is necessary in operating the hydraulic primary and spindle brakes, which are also self-compensating. Turning a small handle at the front of the headstock disengages the spindle, so that it can be easily turned by hand, while the other mechanism remains locked by the primary brake. All speeds, and the forward, brake, and reverse movements of the spindle are controlled by a handle on the apron and on the front of the headstock. The sensitive control permits the spindle to be "jogged" to twenty or thirty positions in one revolution by means of the apron control handle, when the machine is set for a spindle speed of 100 R.P.M.

The pump-operated lubricating system is so designed that when the oil runs below the proper level, the machine will be stopped automatically. There are eighty-eight roller and ball bearings in the standard 24-inch machine, including the Timken spindle bearings.

The weight of the carriage is partially supported on ball-bearing rollers, but the carriage always maintains sliding contact with the bed. The same ball-bearing roller construction is employed for the heavy tailstock. The driving motor can be mounted on the headstock or on a hinged plate at the rear of the headstock. The 24-inch machine shown in the illustration weighs 17,400 pounds without the motor. 69



Lehmann "Hydratrol" Lathe Built for Heavy-duty Work

Nicholson Files for Stainless Steel

A new file with teeth that offer unusual resistance to the abrasive effect of such tough, dense metals as stainless and other alloy steels has been placed on the market by the Nicholson File Co., Providence, R. I. These new files are made in the Nicholson, Black Diamond, and McCaffrey brands of the company. When properly used, with a light pressure and a slow, steady stroke,

To obtain additional information on equipment described on this page, see lower part of page 716.

it is claimed that the new files will remove the metal rapidly and leave a good finish. Each file in this line is stamped on its tang "For Stainless Steel." All three brands of files made for use on stainless steel are available in the same shapes and sizes as the general-purpose files. 70

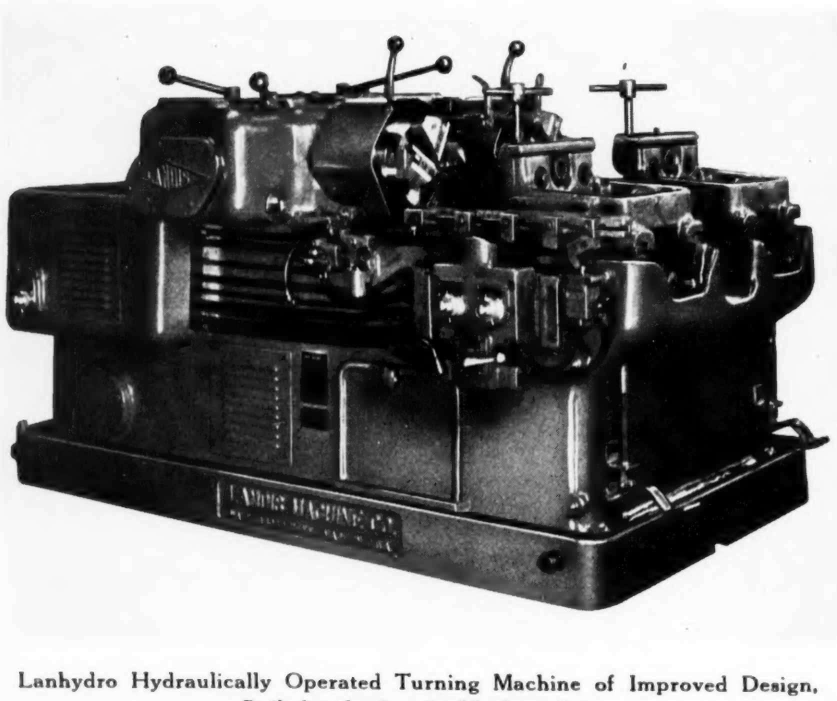
Landis Improved Hydraulically Operated Turning Machine

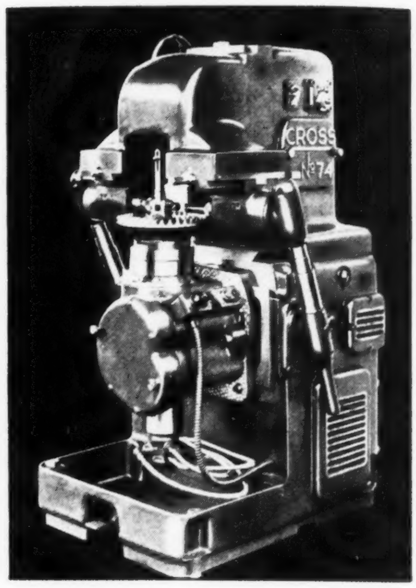
A number of important improvements have been made recently in the Lanhydro hydraulically operated turning machine built by the Landis Machine Co., Inc., Waynesboro, Pa., which was described in June, 1937, MACHINERY, page 688. The hydraulic cycle of the improved machine has been made more flexible to suit all kinds of materials and cutting conditions, and the operation has been greatly simplified.

The operating cycle is now controlled by a foot-pedal, which leaves the operator's hands free for loading and unloading the vises or work-holding fixtures. When the cycle is completed, the work is removed from the vise and another piece inserted, but not clamped. Next, the operator depresses the foot-pedal to start the machine cycle. The carriage then advances rapidly until the work is about to enter the work-center, which is located within the bore of each turning head. At this point, the carriage movement is reduced to a very slow forward speed to permit the operator to guide the work into the work-center, after which he performs the final clamping operation.

The position at which the fast forward speed of the carriage is reduced can be adjusted for work of different lengths. The slow forward movement for centering and clamping the work is also variable. After the work is clamped, the carriage again advances rapidly to the position where the work enters the turning head. A coarse feed is used for the turning operation. This coarse feed can be adjusted to suit any material or turning speed.

If a shoulder is to be faced on the work, the cycle is so arranged that the carriage will advance under a fine finishing feed after it reaches a position within 0.008 or 0.010 inch of the shoulder. This fine finishing feed, like the slow turning feed, is also variable. The carriage advances under the fine finishing feed to a definite stop, where a variable dwell occurs for the final "clean up" cut. which makes it possible to hold the work to length within extremely close limits. After the dwell period, the turning head opens and the carriage returns rapidly to the starting position, thus completing the cycle. The turning head closes automatically during the return movement of the carriage. 71


Lanhydro Hydraulically Operated Turning Machine of Improved Design, Built by the Landis Machine Co.



Cross Universal Gear-tooth Burring Machine

Cross Gear-Burring Machine

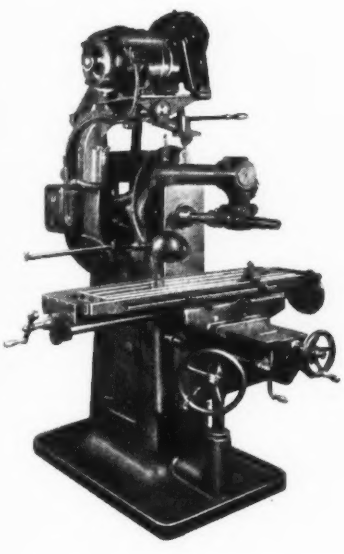
The Cross Gear & Machine Co., 3250 Bellevue Ave., Detroit, Mich., has developed a universal machine (No. 74) for burring and chamfering the teeth of straight bevel, spiral bevel, and hypoid gears. The accurately formed fly cutters used remove the burrs and produce the desired chamfer on both the inside and outside ends of the gear teeth. The average set-up employed on this machine can be completed in fifteen minutes or less, standard indexing change-gears being used to obtain the required variations in the indexing movements.

This machine is completely automatic in operation, stopping automatically in the loading position. It has a capacity for burring gears having a maximum outside diameter of 18 inches, a minimum inside diameter of 3 1/2 inches, a maximum thickness of 7 inches, and from 10 to 80 teeth. Standard equipment includes hydraulic feed and rapid traverse, work-clamping cylinder, and control valve. 72

"Masterdrive" for Machine Tools

A new line of motor drives for punch presses, milling machines, shapers, and lathes, known as "Masterdrives," has been developed by the Industrial Equipment Division of the Master Electric Co., Dayton, Ohio. This line of power equipment is designed to meet the demand for safe, efficient, and economical individual

To obtain additional information on equipment described on this page, see lower part of page 716.



"Masterdrive" Applied to Milling Machine

power units for driving machine tools.

The "Masterdrive" consists of a "Master" geared-head motor and a mounting frame, combined in a single unit that can be attached in a few hours to machine tools of the usual designs. A wide variety of models makes it possible to select a drive that will operate efficiently.

Among the advantages claimed for the new drive are economy; lower upkeep; noise reduction; elimination of delays due to driving equipment failures; and no power costs when the machine is idle. 73

Lincoln Electrode for Welding Stainless Steel

The Lincoln Electric Co., Cleveland, Ohio, has placed on the market a new arc-welding electrode of the 18-8 type having a molybdenum content of 3 1/2 per cent. This new electrode, designated "Stainweld C," was developed to meet the demand for an arc-welding electrode that would be suitable for use on stainless steels containing approximately 3 1/2 per cent of molybdenum.

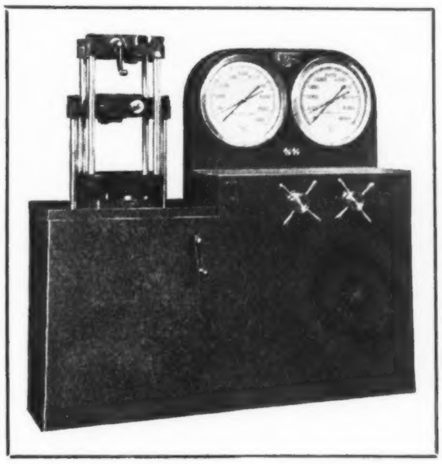
The coating provided on this electrode prevents oxidation of the weld metal and keeps deposits of the weld metal practically the same as that of the parent metal. This is especially advantageous where welding is done on bleaching and dyeing equipment which is required to resist the action of acids. The electrode is made in 1/8-, 5/32-, and 3/16-inch sizes, and in lengths of 11 1/2 inches. 74

To obtain additional information on equipment described on this page, see lower part of page 716.

Olsen Hydraulic Testing Machine

To meet the increasing demand from foundries, welding and specialty shops, vocational schools, small colleges, and manufacturing concerns for a moderate-priced hydraulic testing machine, the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., has developed the compact L type hydraulic testing machine here illustrated. This machine has a capacity of 20,000 to 60,000 pounds, yet its over-all height is but 63 1/2 inches and it occupies a floor space of only 10 square feet. The approximate net weight of the machine is 2000 pounds.

The necessary testing strain is supplied by a moving hydraulic piston. A direct-connected gear pump, running at a constant speed, operates the piston smoothly without producing measurable pulsations. The testing speeds, ranging from 0 to 2 inches per minute in stepless intervals, are controlled by a pilot handwheel 8 inches in diameter. A separate pilot handwheel is furnished with an additional valve for holding or removing the load.



Olsen Hydraulic Tension, Compression, and Transverse Testing Machine

The piston and cylinder are accurately ground and fitted, so that they require no packing. Any slight leakage is compensated for by the oil used in the loading system, which forms a seal between the piston and the cylinder. Friction is thus reduced to a minimum, and the load is weighed within the close limits set by A.S.T.M. specifications. The crosshead has an adjustment of 15 inches, obtained by means of a hand-crank. The enclosed gripping mechanism, actuated by a gear and rack, provides a positive means of opening and closing the grips. The grips are of the wedge type which operate in a tapered opening in the head. The grips are made with machine-cut teeth.

The indicating gages are isolated from the machine proper, being located on a separate instrument panel. The cylinder is in the base of the machine. Loading and unloading are performed through separate controls for each operation. The oil reservoir, bolted to the base of the machine, serves as a support for the motor and pump, which are direct-connected by a flexible coupling that eliminates noise and slippage. 75

Elmes High-Speed Hydraulic Press

The Charles F. Elmes Engineering Works, 222 N. Morgan St., Chicago, Ill., has just brought out a new high-speed hydraulic drawing and forming press having control features designed to provide extreme sensitivity and accuracy. The moving platen, which is guided on four adjustable gibs, can be lowered a fraction of an inch at a time to facilitate setting the dies. The platen stroke can be adjusted so that the idle stroke is of minimum length, in order to increase production.

The bed is arranged for a cushioned cylinder, and all moving parts are pressure-lubricated. The top head

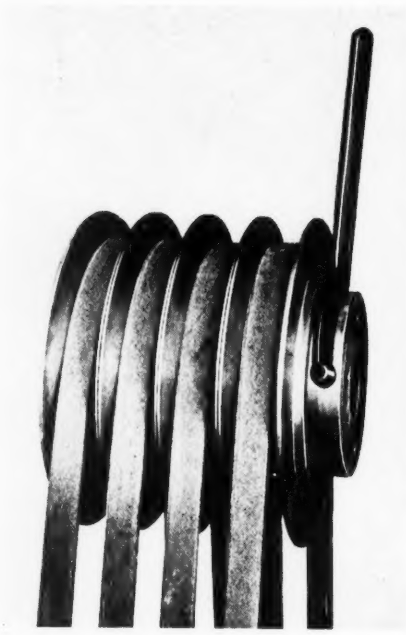
Elmes Hydraulic Drawing and Forming Press

serves as an oil reservoir, as well as a base for mounting the pump, motor, and controls. All control equipment is fully enclosed, making a complete self-contained unit, including the motor starter. Electric lamps inserted in openings in the two side housings direct their light on the dies. 76

Adjustable-Diameter "Wedgebelt" Pulley

The American Pulley Co., 4214 Wissahickon Ave., Philadelphia, Pa., has developed an adjustable-diameter "Wedgebelt" pulley of simplified design to meet the need for a low-cost device for varying the speeds of industrial machines. Speed adjustments can be made quickly by simply turning the adjustable collar of the pulley with a spanner wrench, applied as shown in the illustration.

As the adjustable collar is turned, the side walls that make up each groove are moved endwise to increase or decrease the pitch diameter. The two side walls move in or out simultaneously, thus maintaining accurate belt alignment with the groove in the companion pulley. On the A-groove type pulleys, the maximum speed change ranges from 22 to 33 per cent; on the B-groove type, from 18 to 25 per cent; and on the C-groove type, from 15 to 20 per cent. By using adjustable-diameter pulleys on both the motor and driven shafts, a wide range of speed variations can be obtained. 77



Adjustable-diameter Pulley Made by the American Pulley Co.

Universal Testing Machine

A universal testing machine for tensile, transverse, and compression testing, with a maximum capacity of 60,000 pounds, has been designed by the Detroit Testing Machine Co., 5137 Trumbull Ave., Detroit, Mich. The testing load is applied hydraulically by means of a motor-driven pump. The pump, motor, reservoir, etc., are located in the base of the machine. Movement of a valve lever causes the ram to move up or down rapidly, the rate of loading being automatically maintained by an auxiliary valve, which may be set to suit conditions.

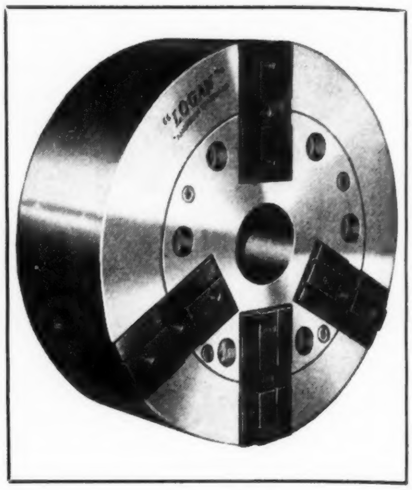
The transverse table, posts, head, etc., are full-floating while tensile testing, eliminating any possibility of misalignment of the specimen or friction in the ram. For transverse or compression testing, the floating unit is guided in a rigid yet frictionless manner. The change from tensile to compression testing can be made instantly without tools.

Universal Testing Machine Developed by the Detroit Testing Machine Co.

Additional load gages of different ranges and grips of various types are available to suit specifications. The load gages may be mounted on the wall in back of the machines; a suitable wall bracket can be furnished for this purpose which takes the place of the gage stand shown at the right in the illustration. 78

Logan Two-Purpose Lathe Chuck

Logansport Machine, Inc., 910 Payson Road, Logansport, Ind., has recently brought out a dual-purpose chuck which consists essentially of the standard three-jaw chuck with a fourth jaw directly opposite one of the three regular jaws. By changing the position of the false jaws, the chuck is easily converted from a three-jaw to a two-jaw chuck or vice versa, thus saving considerable time.

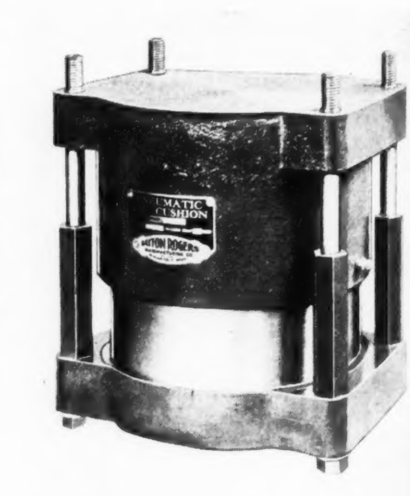


Logan Combination Two- and Three-Jaw Chuck

The cost of this two-purpose chuck is only slightly more than that of the standard three-jaw chuck. It is made in sizes from 12 inches up, with combination or serrated step-along jaws. 79

Dayton Rogers Pneumatic Die Cushion

A single-unit Model C pneumatic die cushion has been added to the line of the Dayton Rogers Mfg. Co., 2830 Thirteenth Ave., S., Minneapolis, Minn. This general utility cushion is



Dayton Rogers Single-unit Pneumatic Die Cushion

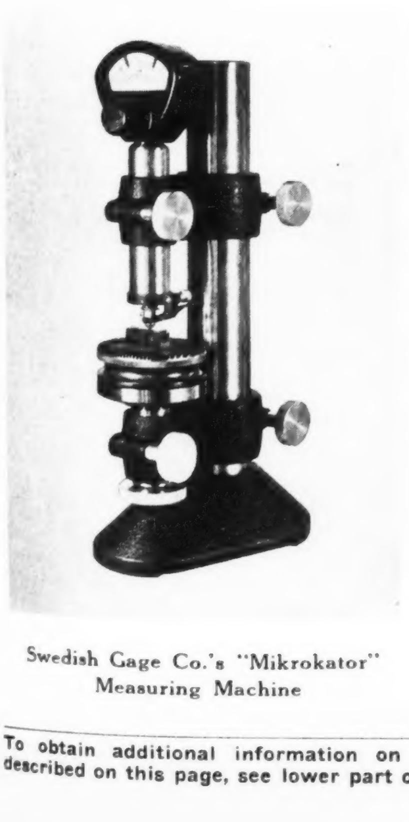
To obtain additional information on equipment described on this page, see lower part of page 716.

made in six sizes having piston diameters that range from 6 to 16 inches, the difference in the diameters of succeeding sizes being 2 inches. The drawing capacities of these cushions range from 3 to 7 inches. No surge tanks are necessary in drawing shells up to a depth of 1 1/2 inches when using this cushion.

The cushion is so designed that it can be attached directly to the bottom side of the bolster plate on most inclinable or straight-side punch presses. When the die cushion is not needed, as for instance, in performing blanking and piercing work, the air in the cylinder can be released so that the pin plate will drop down or retreat to its lowest position to allow the blanks and pierced slugs to drop through the opening in the bolster plate. A pneumatic regulator and gage are furnished, which automatically determine the air pressure used and maintain a predetermined pressure on the cushion cylinder. 80

"Mikrokator" Precision Measuring Instrument

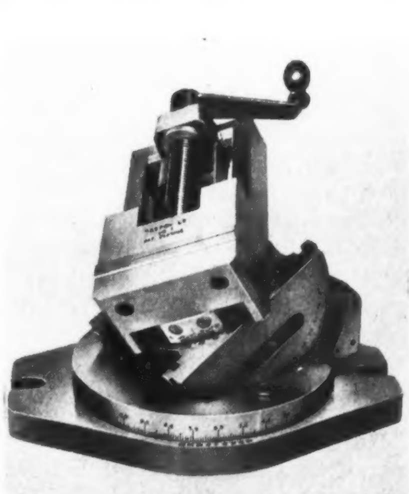
A precision measuring instrument that can be furnished with scales graduated to 0.0001, 0.00005 and 0.00002 inch, with scale divisions of sufficient width to be easily read to one-half of a graduation, has been added to the line of precision measuring instruments of the Swedish Gage Co. of America, 7310 Woodward Ave., Detroit, Mich. This instrument, known as the "Mikrokator," operates on a new principle embodying nearly frictionless amplification. It is designed to assure positive repeat readings to an extremely high degree of accuracy. The instrument has unusual "dead-beat" characteristics. The light weight of the moving parts makes it possible for the pointer to respond instantly to the slightest movement of the measuring tip without swinging past the true reading position. 81



Swedish Gage Co.'s "Mikrokator" Measuring Machine

Wesson Universal Vise Provided with Vernier Scales

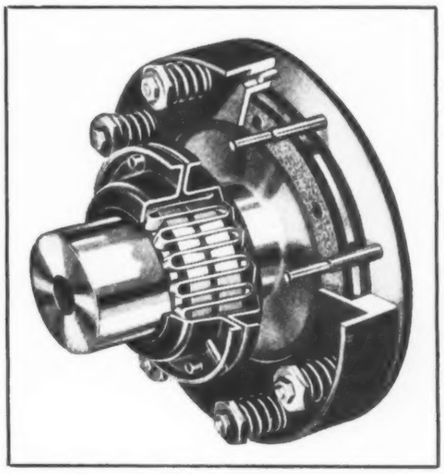
The universal vise made by the Wesson Co., 1050 Mt. Elliott Ave., Detroit, Mich., which was described in November, 1938, MACHINERY, page 238, is now available with vernier scales for all angular adjustments, as shown in the illustration. The addition of the vernier scales makes it possible to obtain angular settings that are accurate within plus or minus 15 minutes. 82



Wesson Vise with Vernier Scales for All Angular Adjustments

Falk Controlled-Torque Steelflex Coupling

The Falk Corporation, Milwaukee, Wis., has brought out a new product known by the trade name "Falk Controlled-torque Steelflex Coupling." This coupling has been developed to provide a dependable means for protecting mechanical drive systems against damage caused by overload shocks. It affords protection against peak loads, which range anywhere from 500 to 1000 per cent of the normal torques and which frequently cause shafts to break and damage housings, as well as other equipment.

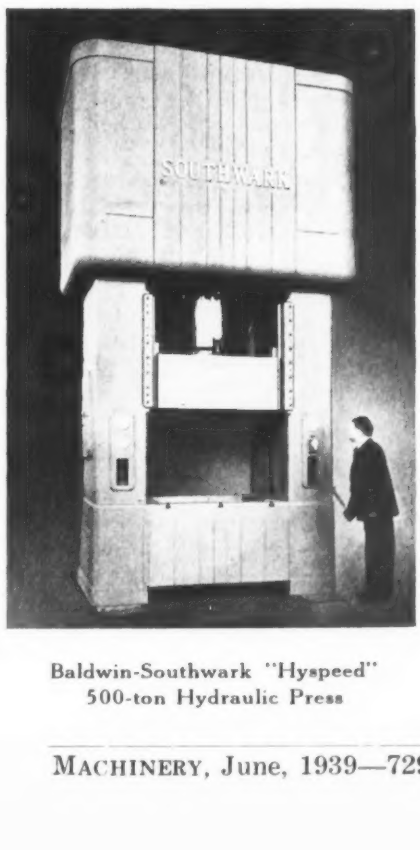


Steelflex Coupling Made by Falk Corporation

In addition to its ability to slip under instantaneous high peak loads, it is claimed that this coupling, having all the basic characteristics of the ordinary Steelflex type, also performs the usual operations of a truly resilient coupling, such as damping out shocks, reducing vibration, and permitting parallel and angular shaft misalignment. 83

Baldwin-Southwark 500-Ton Hydraulic Presses

The Baldwin-Southwark Corporation, Paschall P. O., Philadelphia, Pa., recently built at its Eddystone shops, three 500-ton single-acting "Hyspeed" hydraulic presses for use

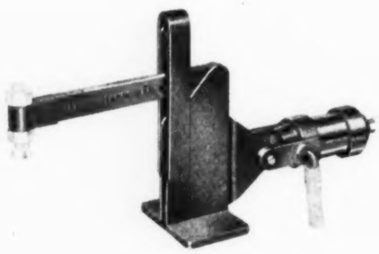


Baldwin-Southwark "Hyspeed" 500-ton Hydraulic Press

To obtain additional information on equipment described on this page, see lower part of page 716.

in the production of automobile stampings. These presses are capable of making 22 short working strokes a minute, and have a full-stroke capacity of 20 inches. The platen area is 48 by 41 inches, and the downward moving platen is equipped with an adjustable stripper.

The presses can be operated manually, semi-automatically, or as completely automatic machines. They are of the self-contained, oil-operated type. The side housings are of cast steel, and the pump, motor, and valves, located on top of the press, are readily accessible. 84

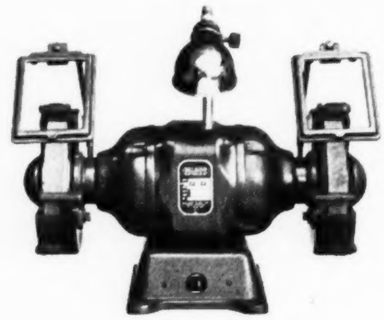


"De-Sta-Co" Air-actuated Toggle Clamp

Air-Actuated Toggle Clamp

The Detroit Stamping Co., 3435 Fort St., W., Detroit, Mich., has placed on the market a new "De-Sta-Co" air-actuated toggle clamp. This clamp has a built-in air cylinder which is connected to the air line and operated by a Ross air control valve. The clamp is especially designed for fixtures used to hold work requiring multiple clamping operations, such as are employed for large sheet-metal panels. For work of this kind, one air valve can be made to control and operate several clamps like the one illustrated.

The compact design of the new clamp permits it to be used in inaccessible places. It has been designed to operate at a speed far in excess of that obtainable with hand-operated clamps, such as are used for drilling, reaming, welding, and assembling operations. 85



Baldor De Luxe Grinder Equipped with Light and Eye-shields

Baldor De Luxe Model Grinder

The Baldor Electric Co., 4357 Duncan Ave., St. Louis, Mo., has recently placed on the market a No. 714 De Luxe model grinder equipped with a 1/2-H.P. motor. This grinder is furnished with 7- by 1-inch wheels made by the Carborundum Co. It is provided with a shatter-proof eye-shield over each wheel and a light that can be swung into position over either wheel. 86

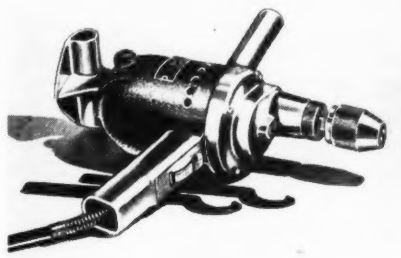
Shuster Motor-Driven Swing-Frame Grinder

The motor-driven suspended type swing-frame grinder here illustrated is a recent development of the F. B. Shuster Co., New Haven, Conn. It is intended for heavy grinding work in smoothing castings, cleaning up steel billets, and polishing sheet metal. Three sizes are available, the smallest using a grinding wheel 16 inches in diameter by 3 inches wide, while the largest accommodates a 24- by 3-inch wheel. The motors, which drive the wheels by V-belts, range from 5 to 15 H.P., and may be of the totally enclosed dustproof type.

The machine is supported by a swiveling yoke, and can be swung through a complete circle. It can also be tilted, so that the wheel-spindle is inclined at any angle up to 90 degrees with the horizontal. A clamping attachment, actuated from the operating position, permits locking the machine at the required angle, the balance being maintained in all positions. The smallest machine has an over-all length of 96 inches and a width of 22 inches. It weighs approximately 700 pounds equipped with an alternating-current motor, and 800 pounds equipped with a direct-current motor. 87

Speedway Portable Drill

The Speedway Mfg. Co., 1834 S. 52nd Ave., Cicero, Ill., has brought out a new portable electric drill of 1/2-inch capacity that is a radical departure from all previous drills made by this company. This drill, which weighs but 9 1/2 pounds, has a combination breast and end handle, which is gripped crosswise for applying power directly behind and in line with the drill point.



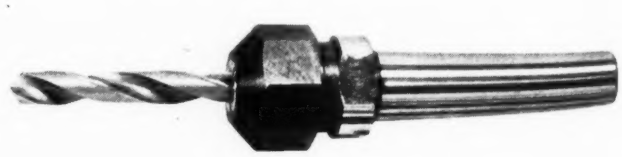
Speedway Portable Drill of 1/2-inch Capacity

The mechanical improvements include a specially wound, high-torque motor operating at a speed of 500 R.P.M. that will not stall under a 500-pound thrust while drilling at maximum capacity; improved air cooling; self-aligning oilless bearings; removable side handle for close-quarter operation; and sliding thumb switch. 88

Improved Universal Chucks

The Universal Engineering Co., Frankenmuth, Mich., has recently

Motor-driven Swing-frame Grinder Made by the F. B. Shuster Co.

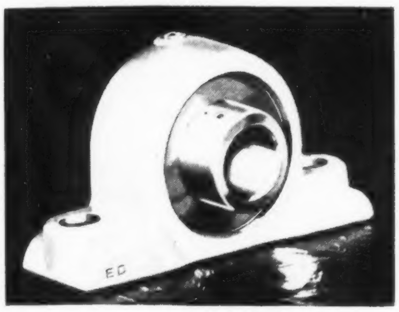


Improved Collet Chuck Made by the Universal Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 716.

made two improvements in the collet chucks of its manufacture. One improvement consists of grinding the threads from the solid after hardening; the other is the provision of a handy wrench grip section which is machined on the chuck shank.

Two new sizes have been added to the line of collet chucks made by this company, the Type OW having a range of from 1/16 to 3/16 inch, and the Type XZ a range of from 3/4 inch to 1 1/2 inches. With the addition of these two new sizes, the range is increased to include sizes of from 1/16 to 1 1/2 inches. 89

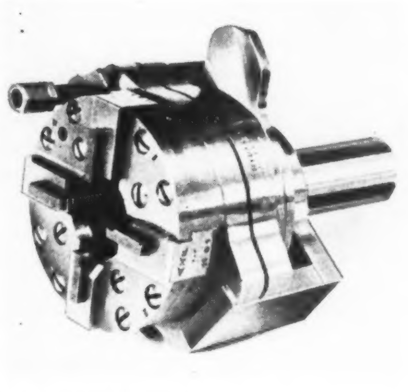


Ahlberg Light-duty Ball-bearing Pillow Block

Ahlberg Ball-Bearing Pillow Blocks

A new series of low-priced, light-duty, ball-bearing pillow blocks has been brought out by the Ahlberg Bearing Co., 317 E. 29th St., Chicago, Ill. These pillow blocks, known as Series ED, are designed for light machine applications where the cost of ball bearings has heretofore been prohibitive. They consist of a specially designed Ahlberg single-row bearing in a sturdy die-cast housing. The ball bearing provides for shaft deflection up to 1 degree.

The seals employed with this bearing are of a floating type, which eliminates friction and increases the life of both the seals and the bearing. The seals are made of Neoprene, a synthetic rubber that is not affected by oil or grease. This bearing is made in seven sizes for shafts ranging from 1/2 inch to 1 3/16 inches in diameter. 90



Die-head Brought out by Eastern Machine Screw Corporation

Die-Head for Brown & Sharpe Automatics

The Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn., has added a new size to the Style DM die-heads for Brown & Sharpe automatics, which is known as No. 1101. This die-head has been designed for use on the No. 2 machine. Although it measures less than 2 7/8 inches in diameter and weighs only slightly over 4 pounds, it has a capacity for threading work up to 1 inch in diameter.

In size, the new head is approximately half way between the No. 101 and No. 102 Style DM heads, described in December, 1938, MACHINERY, page 303. The chasers used in both of these sizes, however, can be employed in the new die-head. The die-head is equipped with a front end trip for threading close to a shoulder. It can also be tripped by the usual pull-off method. 91

Lathe Tool-Holder Using Tools Made from Round Rods

A lathe tool-holder designed to hold tools made from round high-speed steel rods has been brought out by the Southwest Mfg. Co., 1623 E. First St., Santa Ana, Calif. This holder is made in sizes to take tool steel rods 7/32, 1/4, 5/16, and 7/16 inch in diameter. Each holder is furnished with a tool ready for use. Tools made from high-speed steel rods are available with the ends forged and ground to various shapes, as required for such operations as boring, inside threading, centering, armature turning, thread cutting, and cutting-off operations. 92

Allen Dowel-Pins, Socket-Head Cap-Screws, and Counterbores

A line of "Allenoy" steel heat-treated and hardened "Tru Ground" dowel-pins having a tensile strength of 240,000 to 250,000 pounds per

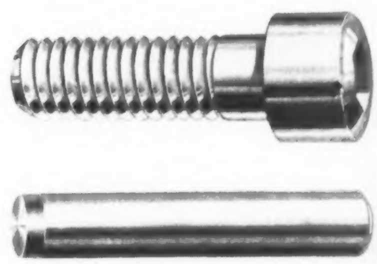


Fig. 1. Allen Dowel-pin and Socket-head Cap-screw

square inch has been brought out by the Allen Mfg. Co., Hartford, Conn. These dowel-pins are intended for use in punch and die work as locating pins and for machine assembly purposes. They are available in thirty-eight different lengths ranging from 3/8 to 6 inches, and in eleven diameters ranging from 1/8 to 1 inch.

The socket-head cap-screw of "Allenoy" steel shown with the dowel-pin in Fig. 1 is another new product of the company. The entire screw is cold-formed in a continuous operation which leaves the steel fibers unbroken from the top to the bottom of the screw. The "Pressur-Formd" process is employed to insure accurate sockets, uniformly accurate threads, a head diameter held closely to size, and a high degree of accuracy in the concentricity between head and body. These cap-screws are made with both American Standard Fine and Coarse Threads, and are

Lathe Tool-holder and Tool Made by the Southwest Mfg. Co.

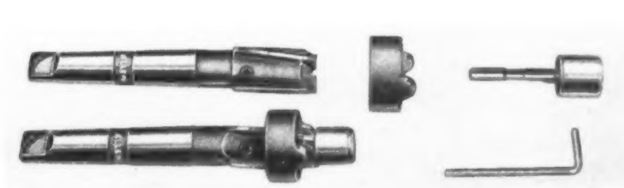


Fig. 2. Allen Counterbores with Removable Pilots and Depth Gage Collars

To obtain additional information on equipment described on this page, see lower part of page 716.

available in sizes ranging from No. 8 up to 1 inch in diameter, and in lengths from 1/4 inch to 6 inches.

Still another new development consists of a set of six counterbores ranging from 1/4 to 5/8 inch in diameter. The cutters of these tools are made from high-speed steel. The pilots can be easily removed, as shown in Fig. 2, to permit grinding. The counterbored holes produced by these tools are from 0.015 to 0.025 inch larger than the screw heads. An adjustable collar is provided to govern the depth of the counterbore. 93

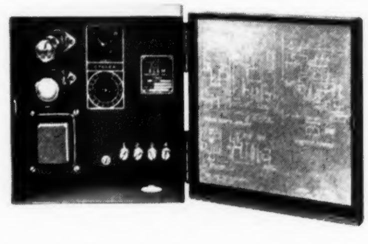
"Timeter" Equipped with Indicating Lamp

A device designed to serve the two-fold purpose of keeping an accurate record of the actual production hours of a machine and of showing at a glance, by means of an indicating lamp, if the machine is in operation, has been brought out by the National Instrument Co., 44 School St., Boston, Mass. This device, known as a "Timeter," consists of an electrically operated counter which automatically registers the total number of hours that any electrical device or motor-driven machine has been in operation. It is operated by a small slow-speed self-starting synchronous motor which drives a set of numbered wheels through a gear train. This instrument is applicable to a wide range of production machines and testing equipment, including heat-treating furnaces; pulverizing and grinding mills; refrigerating equipment; radio transmitters; life tests on lamps, tubes, etc.; and educational and research laboratories. 94

"Timeter" with Red Jewel which Shows when Machine is in Operation

Neotron Timer for Spot, Butt, and Projection Welding

For automatically controlling the length of time the current flows through pieces being welded on spot, butt, and projection welding machines, the Electric Controller & Mfg. Co., 2706 E. 79th St., Cleveland, Ohio, has brought out the E C & M "Neotron" weld timer. The operation of this device is based on the fact that a certain time is required to charge a condenser to a predetermined voltage. When this charge is reached, the condenser discharges through a neon tube, opening the magnetic contactor handling the main power circuit to the weld-



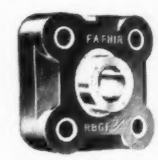
"Neotron" Weld Timer Made by Electric Controller & Mfg. Co.

ing machine, thus giving a definite time for each weld.

The timer illustrated, when used on 60-cycle frequency, permits selecting any desired welding time from 1/2 to 60 cycles. Adjustment of the timing is made by operating two small dials on the front of the panel. A larger condenser can be provided for timing operations that require a longer welding period. The "Neotron" timer, in the standard form, is intended for use with manual-, motor-, or air-operated welders. The automatic, non-repeat form, with non-beat and hold features, is available for operation on air-operated welding machines. It is also available in the automatic repeat type, which has the non-beat, hold and squeeze features. The over-all dimensions are 9 by 8 1/2 by 7 inches. 95

Fafnir All-Rubber Bearing Cartridges

A rubber cartridge bearing unit for all standard shaft diameters from 3/4 inch to 1 7/16 inches is made by the Fafnir Bearing Co., New Britain, Conn. Each unit embodies a Fafnir wide inner-ring ball bearing with self-locking collar, bored to English rather than metric dimensions, and to a slip fit on stock size shafting. This unit can be easily installed without lock-nuts, sleeves, or adapters, and without performing machining operations. It is made in both flange and cylindrical cartridge units.



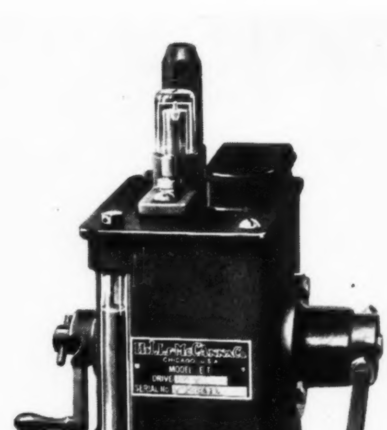
Fafnir All-rubber Bearing Cartridge

The resilient housing of the bearing unit insulates the bearing, absorbs noise and vibration, and automatically compensates for small errors in alignment and for longitudinal shaft expansion. Although developed primarily for the heating, ventilating, and air-conditioning fields, these units should be useful in a variety of mechanical applications. 96

Hills-McCanna Lubricator

A force-feed lubricator capable of positively delivering any amount of oil required, from a fraction of a drop to ten drops per stroke, at a pressure of 2000 pounds per square inch is being placed on the market by the Hills-McCanna Co., 2349-59 Nelson St., Chicago, Ill. This lubricator has been especially designed to meet present-day high-pressure bearing and stuffing-box lubrication requirements. Fine-mesh screens in the pump valve filter the oil and keep foreign particles from entering the feed-lines.

The built-in sight feed, which is



Force-feed Lubricator Made by the Hills-McCanna Co

To obtain additional information on equipment described on this page, see lower part of page 716.

not under pressure, is made of a new unbreakable, transparent, plastic material known as "Lucite." This lubricator is available in single- or multiple-feed assemblies, each valve being independently adjusted. The drive consists of a positive ratchet enclosed within the reservoir. 97

"Langsner" Industrial Slide-Rule

The Eugene Dietzgen Co., 2425 Sheffield Ave., Chicago, Ill., is manufacturing a slide-rule designed to solve industrial problems in a simple manner with only one movement or setting of the slide. This slide-rule, known as the "Langsner," has six scales on its face, although there is only one slide. Problems involving surface speeds, cutting speeds, diameters of cutters, drills, etc., required R.P.M. of work, feed ratios, length of cut, time-study data, etc., can be solved almost at a glance.

The rule is 10 inches long, has engine-divided graduations on white celluloid, with glass "frameless" indicator, and is packed in a case with a book of instructions. 98

Numberall Marking Device

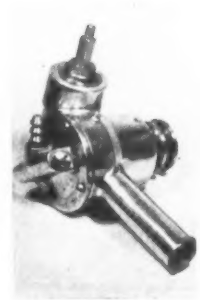
The Numberall Stamp & Tool Co., Huguenot Park, Staten Island, N. Y., has brought out a marking device (Model No. 47) which can be used for marking a great variety of small parts, plates, etc. Round or cylindrical parts can be marked with this device by using a V-block. The marking stand can also be used for light riveting operations.

Numbering heads, "Numberall" rotary stamps, type stamps, marking dies, automatic spacers for nameplates, single letter or figure stamps, trademark dies, etc., can all be used in this stand. Work-holding fixtures can be furnished when desired. 99

Numberall Marking Device for Cylindrical or Flat Surfaces

Stow Flexible-Shaft Angle-Head for Grinding and Polishing Wheels

An improved angle-head has been developed by the Stow Mfg. Co., Binghamton, N. Y., to fit flexible shafts 2A, 3A, 4A, and 5A made by the company. This head is especially designed for heavy-duty cup-shaped grinding wheels, brushes, and sanding and polishing sets. It is 3 1/2 inches in diameter, 6 1/8 inches high, and is built to run at speed reduction ratios of from 1 to 1 down to 20 to 1. The spindles run in oversize grease-sealed ball bearings. The angle-head is sealed and is adapted for wet or dry grinding. 100



Stow Flexible-shaft Head

Metal Trades Association's Meeting in Chicago

The National Metal Trades Association held its forty-first annual convention at the Palmer House, Chicago, Ill., May 24 and 25. An unusual number of informative and thought-provoking papers were presented, relating both to the management side of industry, and to the effect upon industry of present political trends.

Among the papers in the former classification should be mentioned "The Use and Application of Job Rating," by A. L. Kress, National Metal Trades Association; E. L. Berry, assistant general manager, Link-Belt Co., Chicago, Ill.; and Howard Goodman, vice-president, Goodman Mfg. Co., Chicago, Ill. A report entitled "Merit Rating or Employe Analysis" was presented by the Association's committee on the subject, of which O. D. Reich, vice-president of the Dexter Folder Co., Pearl River, N. Y., is chairman. Dr. Otto P. Geier, Cincinnati Milling Machine Co., Cincinnati, Ohio, presented a paper on "Member Interest in Employe Hospitalization."

Among the general topics covered in papers at the convention were "The Future Demand for Capital Goods in the United States," by George H. Houston, New York City; and "Adventures in Electricity," by Dr. Phillips Thomas, research engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Addresses relating to the political aspect as it affects industrial peace and welfare included "Uncovering Un-Americanism," by John C. Metcalfe, former chief investigator, Dies Committee on Un-American Activities; "Three Strikes, No Hits, One Fuehrer," by W. J. McCulloch, foreign news editor, The Spectator, Hamilton, Ont., Canada; "The Liquidation of Thrift," by Samuel B. Pettengill, former Congressman from Indiana; "Stand on Your Rights and Go Ahead," by David R. Clarke, Fyffe & Clarke, Chicago, Ill.; and "What is Happening in Washington?" by John W. O'Leary, chairman, executive committee, U. S. Chamber of Commerce, Washington, D. C.

At the annual dinner Wednesday evening, May 24, two addresses were made, one by Colonel Roscoe Turner on "Speed in Aviation," and another by the Honorable Julius P. Heil, governor of Wisconsin, entitled "Partners—Men and Management."

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Change in Publication of A.S.T.M. Standards

The American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., announces that important modifications are to be made in the method of publishing the Society's standard specifications and tests, due to the great growth in its standardization work. These changes will become effective next November. The major change is to combine the Book of Standards (issued triennially) and the Book of Tentative Standards (issued annually) and to publish the combined work triennially. In the two years between triennial publication of the new book, supplements will be issued containing new or revised standards and tentative standards for that year.

To obtain additional information on equipment described on this page, see lower part of page 716.

Equipment for Grinding "Chip Curler" Groove in Carbide Tool Tips

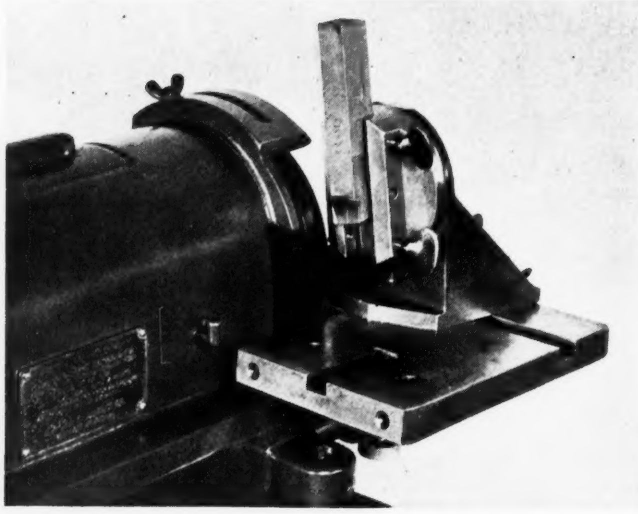

Fig. 1. Ex-Cell-O Bench Type Carbide Tool Grinder Equipped for Grinding "Chip Curler" Groove

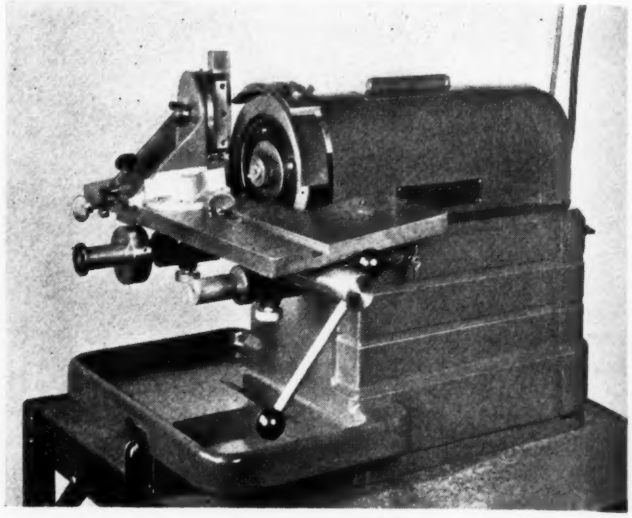

Fig. 2. Front View of Ex-Cell-O Machine Shown in Fig. 1, as Equipped for Grinding "Chip Curler" Groove

IN machining steel parts with carbide-tipped tools, some means of controlling the chip formation is required. Usually this is accomplished by grinding a "chip curler" groove on the top face of the carbide tool tip, as shown in Fig. 3. Ordinarily, this is done on a surface grinder, with the tool set up on a magnetic chuck or in a universal vise. This is a rather slow and expensive method. The carbide tip may be checked by the heat generated in grinding, since the wheel is not usually supplied with coolant. The edge of the tip may also be chipped as a result of wheel pressure and vibration.

To overcome these difficulties and to facilitate the grinding of properly shaped "chip curler" grooves in carbide tools, the Ex-Cell-O Corporation, 1212 Oakman Blvd., Detroit, Mich., with the cooperation of the Carboloy Company, Inc., also of Detroit, has designed the "chip curler" grinding equipment shown in Figs. 1 and 2. This equipment consists of a special tool-rest table, an adjustable tool-holder, and a protractor for the Ex-Cell-O bench type carbide tool grinder. The tool to be ground is clamped in the holder, tip down, as shown. It can then be set quickly to the exact angle desired by means of the table adjustment cam, protractor, and tool-holder dial. After being adjusted to the correct position, the tool is fed into the wheel by hand pressure, which is less likely to cause chipping of the tip edge.

A diamond-impregnated wheel is used for the grinding operation, coolant being piped to the wheel from a reservoir cast in the machine. This combination of diamond wheel and coolant results in a fast cutting action, which not only reduces the grinding time, but also leaves a sharp cutting edge and a smooth surface.

"Chip curler" grooves can be ground with this equipment in single-point, straight-shank carbide-tipped tools in sizes up to one inch square or any other shape of equal cross-section. The equipment is adapted for grinding "chip curler" grooves in tools used for boring, facing, and turning on lathes, boring mills, and screw machines.

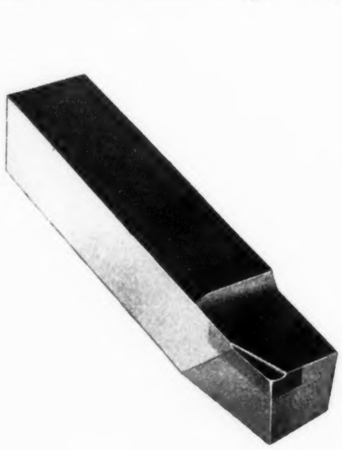

Fig. 3. Carbide-tipped Tool with "Chip Curler" Groove Ground in Tip

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Artificial Lightning Becomes Factory Equipment

Artificial lightning, heretofore considered a laboratory aid, has now become a transformer-factory shop tool, operated by members of the factory organization. A demonstration of man-made "hot" lightning was made by Westinghouse engineers at Sharon, Pa., on May 8, simultaneously with the inauguration of an artificial lightning test for all distribution transformers of the completely self-protected class.

All lightning-proof distribution transformers, as they come from the production line, are routed through a test room, where they are subjected to direct "strokes" from a lightning generator. Each transformer receives its baptism of lightning by applying to each terminal a surge that rises at the rate of 1,500,000 volts in a millionth of a second, and is followed by the tremendous flood of current of 55,000 amperes. Every three minutes a transformer comes from the production line completely surge-tested.